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ABSTRACT

This volume consists of advanced job and task sheets adaptable for use in the regular vocational industrial education programs for the training of machinists and machine shop operators. Twenty-one advanced machine shop job sheets are included. Some or all of this material is provided for each job: an introductory sheet with aim, checking standards, and references; drawing(s); a job sheet that details the job, materials, tools and equipment, general instructions, procedures and/or tasks, and checkpoints; and task sheets. These task sheets are broken down into steps and key points for ease of carrying the learner through the job step-by-step and are keyed to work stations and machines of a machine shop. These 21 jobs are covered: flat head machine screw, spotfacer bar, go and no-go plug gages, plug gage handle, taper plug gage, lathe center, spur center, cup center, tool post wedge, parallel clamp, C-clamp, tool maker's vise, cast iron gear, taper ring gage, morse taper sleeve, single-point scriber, double-point scriber-A, double point scriber-B, V-blocks, standard ring gages, and tap wrench. (YLB)

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MACHINE SHOP

Suggested Job And Task Sheets

Part II

21 Advanced Jobs

CE038892

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A

SUGGESTED SET OF JOB AND TASK SHEETS

FOR

MACHINE SHOP TRAINING

PRINTED 1977

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FOREWORD

The job and task sheets included in this series are an advanced continuation of Part I. This series is adaptable for use in the regular vocational industrial education programs for the training of machinists and machine shop machine operators.

In the planning of this series of advanced job and task sheets a concerted effort has been made to include those articles that are useful, as well as excellent learning experiences. This will have the results of not only conserving materials but will stimulate the interest of learners at their work.

Suggestions are included for teachers which may be of help in making the best use of the job and task sheet series.

Part II consists of twenty-one advanced machine shop job series. Each job is accompanied by task sheets. The task sheets are broken down into steps and key points for ease of carrying the learner through the job step by step. The task sheets are keyed to work stations and machines of a machine shop. Where a task has been written for a previous job, reference will be made to the task and task number.

I. USE OF THE JOB SHEET SERIES

In compiling the jobs for this series, all essential details of production procedures necessary to train an operator for a special unit skill occupation have been considered and included as far as possible. It will, however, be necessary for the instructor to analyze each job as assignments are made to learners and check to be sure that all information necessary for instruction is included on the job and task sheets.

If the details on the job and task sheets do not wholly meet the needs of the learner, it will be necessary for the instructor to expand or modify the information to conform to the situation at hand. After desirable modifications have been made, it is expected that the instructor will arrange for the reproduction of a sufficient number of sheets to accommodate the learners.

In helping the learners with new experiences, instruction supplementary to the information given on the job and task sheets should always be in order. This may take the form of a shop demonstration, a shop talk, working with the individual learner, or referring the learner to suitable reference materials. Safe methods of working in connection with the assigned jobs must always be emphasized.

The job and task sheets are set up in such a fashion as to lead the learner in the learning process from the simple to the complex. As the learner progresses through the twenty-one jobs more machines are used with the setup and operations becoming more complex, thereby offering a more challenging experience to the learner. Many opportunities have been built into the jobs to afford the learner the occasion to become experienced in making judgements and decisions concerning procedures, processes, and calculations. Some tasks require the designing and constructing of special tooling, thereby adding to the experiences of the learner.

It will be noted that all of the projects require more than one task for completion. As this occurs a task sheet is included for each new task. In jobs where tasks have been performed previously, reference will be made to that particular task should the learner require the use of the task sheet in performing the given task. In some jobs, special instructions will be given concerning routing of the job and methods by which the learner is to use the task sheets. In all cases, the training requires that the job be routed from one training station to another in proper sequence. The intent here is to approximate the production plan in industry and assure effective training for a given learner in a unit skill occupation.

It should be noted that in the use of job and task sheets the learner is given the drawing, job sheet, and task sheet to assist and guide in performing the task. (It is suggested that each learner performing a specific job be given a complete set of job and task sheets.) Where possible, the job and task sheets should be laminated in plastic or inserted in plastic folders to protect against damages caused by handling. This permits use of job and task sheets over again.

Use of Tolerances

The tolerances specified on the drawings in this series are made to conform to standard industrial practice as nearly as possible. These tolerances should be adhered to as nearly as shop conditions will allow; otherwise, the training will not completely serve its purpose. Repetition of a task by the learner until tolerances are attained is essential to qualification for employment in the skilled occupation. This repetition is made possible by organizing the work on a production basis whereby the twenty-one jobs route the learners through the various training stations of a machine shop many times.

Variation in Machine Equipment

The proper sequence of machines or type of task necessary for the completion of each job has been noted on the job sheets. This sequence may be changed whenever necessary to meet shop conditions. In many cases the task may be done with either of two types of machines such as a milling machine or a shaper. In this case the two tasks are detailed on separate task sheets. This is done because of the known limitations of equipment in some shops and also to emphasize the fact that there are often more ways than one to perform a task.

Limitations in Using Job and Task Sheets

The instructor should bear in mind at all times that instruction sheets do not include technical information involved in processing. The demonstration, shop talks, working with learners on the job, or referring learners to specific printed material are always essential supplementary teaching methods that must be used. Additional necessary related information and instruction, such as reading blueprints and making calculations, should be taught as the learners progress through the jobs. Shop reference books and pamphlets should always be at hand in the shop library, and this printed material should be used as needed and required by the learners to obtain information on all aspects of the occupation.

The job and task sheets of this series are set up as suggestions only. It is the instructor's privilege to modify job and task sheets to meet the conditions existing in the shop. At times it will be essential to change information or procedures outlined on the job and task sheets. In this case additional job and task sheets should be provided to meet specific training needs and to include additional jobs.

This job sheet series does not include all the tasks that can be performed on the machines listed. In case training requirements call for other tasks than those found in the Chart of Tasks, the instructor will find it necessary to find other jobs provided to meet specific training needs and to include additional jobs.

The instructor should bear in mind that although it is recommended the learner follow the job and task sheets in the order they are written, the instructor may deviate from the sequence in order to meet the needs of the student or shop situation. Should deviations be necessary, the instructor should make available to the learner those previous job and task sheets the learner has not completed to use as references.

II. USE OF THE DRAWINGS

The drawings provided in connection with each job are working drawings made to conform as closely as possible to industrial standards. The drawings are printed on tracing paper so as to make possible their reproduction in blueprint form by the local schools. It is expected that the learner will become familiar with the reading of blueprints so that the finished product of a job may be visualized and an understanding created of the tasks involved in the job. Instruction in blueprint reading, interpreting specifications, and making necessary calculations must be given with each job.

III. USE OF REFERENCES

The use of references, in any form that will be helpful to the learner, will be an aid to the instructor in successful teaching. The instructor should have available for the learner at all times reference material which will assist the learner in obtaining additional information related to the job on which work is being done.

IV. ANALYSIS OF TASKS

The following chart, Chart for Prints and Job Sheets, lists items to be made, print numbers, and types of tasks involved in the processing. This chart should prove helpful to the instructor in making learner assignments. The chart can be used in connection with a progress chart to check the coverage of the learners' progress through the course. (The jobs covering types of tasks such as bench work, drill press work, etc. are in the learning order, simple to the complex, insofar as possible. The order in which the different types of tasks occur on the chart for a given article does not necessarily represent the order in which the tasks are performed in production.)

CODING OF JOB AND TASK SHEETS

As a means of organizing and arranging the job and task sheets in a sequential order for use and reference, the following coding system is used:

1. Each machine operation, as related to the course outline, is expressed as a unit of instruction and is designated by a roman numeral.
   Example: The unit of instruction, Engine Lathe, is designated by VII.
2. Each job in which the machine or unit of instruction is used is designated by a capital letter.
   Example: The third job in which the Engine Lathe is used would be designated VII-C; that is, VII for unit of instruction and C for the third job in which the Engine Lathe is used.
3. Each task within a job is designated by a number where there is only one task, or a number and a lower case letter where there is more than one task.
   Example: The first task of the third job in which the Engine Lathe is used would be designated VII-C-1; and the second task would be designated VII-C-1a.
4. On jobs containing multiple parts where the machine or unit of instruction is used to construct more than one part within the job, the task number would change to the next number from the previous one.
   Example: The second task of the second part of the third job in which Engine Lathe is used would be designated VII-C-2a.
5. Each job sheet is designated by (J) and entitled and coded to each job with which it is used.
   Example: VII-C-2 (J)
6. Each task sheet is designated by (TS), and entitled and coded to each task to be used in the performance of using that unit of instruction or machine.
   Example: VII-C-2a (TS)

UNITS OF INSTRUCTION

The units of instruction or those machines or operational procedures used in performing a job, as related to the course outline, are as follows:

I. Orientation
II. Measuring
III. Blueprint reading
IV. Bench
V. Power Saw
VI. Drill Press
VII. Lathe
VIII. Shaper
IX. Milling Machine
X. Grinders
XI. Heat Treatment
XII. Welding
XIII. Machine Maintenance

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CHART FOR JOB AND TASK SHEETS

JOB AND PRINT NO.	MACHINE SHOP JOBS	TASKS											
		BENCH	POWER SAW	DRILL PRESS	ENGINE LATHE	TURRET LATHE	SHAPER	MILLING MACHINE	CYLINDRICAL GRINDER	INTERNAL GRINDER	SURFACE GRINDER	TOOL & CUTTER GRINDER	HEAT TREAT
1.	FLAT HEAD MACHINE SCREW				1	1		1					
2.	SPOTFACER BAR				1			2	1				
3.	GO AND NO-GO GAGES	1			2			3	2				1
4.	PLUG GAGE HANDLE				3								
5.	TAPER PLUG GAGE				4				3				2
6.	LATHE CENTERS				5				4				3
7.	SPUR CENTER	2		1	6			4	5				4
8.	CUP CENTER	3		2	7								
9.	TOOL POST WEDGE	4	1				1	5					
10.	PARALLEL CLAMP	5	2	3	8		2	6					
11.	C-CLAMP	6		4	9			7					
12.	TOOL MAKERS VISE	7		5	10		3	8					
13.	CAST IRON GEAR				11		4	9					
14.	TAPER RING GAGE	8			12			10			1	1	5
15.	MORSE TAPER SLEEVE				13			11	6				
16.	SINGLE POINT SCRIBER	9			14			12					
17.	DOUBLE POINT SCRIBER A	10			15								
18.	DOUBLE POINT SCRIBER B	11			16			13					
19.	V-BLOCKS		3					14				2	5
20.	STANDARD RING GAGES	12			17						2		6
21.	TAP WRENCH	13		6	18			15					

NAME: ____________________

PROGRESS CHART

MACHINE SHOP—PART II, PAGE 1

TASKS	BENCH																				DRILL PRESS								SHAPER							MILLING MACHINE													
JOBS	PREPARE SURFACE	LAYOUT	DRILL	COUNTERSINK	REAM	TAP	THREAD	POWER SAW	HAND SAW	CHIP	SHEAR	FILE	DRAW FILE	HAND GRIND	HAND LAP	STAMP	ASSEMBLE	BEND AND STRAIGHTEN	SCRAPE	POLISH	DRILL TO LAYOUT	DRILL WITH DRILL JIG	COUNTERBORE	COUNTERSINK	REAM	TAP	LAP	SPOT FACE	HORIZONTAL SHAPE	VERTICAL SHAPE	RIGHT ANGLE SHAPE	CUT SERRATIONS	ANGLE SHAPE	CUT INTERNAL KEYWAY	FORM SHAPE	SLAB MILL	FACE MILL	END MILL	STRADDLE MILL	FORM MILL	HELICAL MILL	ANGULAR MILL	SLOT	SLIT	HOB GEAR	BORE	INDEX	SPACE	CUT WOODRUFF KEY
26. FLAT HD. MACH. SCREW																																																
27. SPOTFACER BAR																																																
28. GO & NOGO PLUG GAUGES																																																
29. PLUG GAUGE HANDLE																																																
30. TAPER PLUG GAUGE																																																
31. LATHE CENTER																																																
32. SPUR CENTER																																																
33. CUP CENTER																																																
34. TOOL POST WEDGE																																																
35. PARALLEL CLAMPS																																																
36. C-CLAMPS																																																
37. PLANER JACK																																																
38. TOOLMAKER'S VISE																																																
39. CAST IRON GEAR																																																
40. TAPER RING GAUGE																																																
41. MORSE TAPER SLEEVE																																																
42. OIL QUILL																																																
43. SINGLE POINT SCRIBER																																																
44. DOUBLE POINT SCRIBER-A																																																
45. DOUBLE POINT SCRIBER-B																																																
46. VEE BLOCKS																																																
47. STANDARD RING GAUGE																																																
48. TAP WRENCH																																																
49. RADIUS CUTTER																																																
50. SURFACE GAUGE																																																

PROGRESS CHART

NAME: ______________________

MACHINE SHOP—PART II, PAGE 2

	TASKS JOBS	ENGINE LATHE																									TURRET LATHE														INT. GR.				SURF. GR.				CYL. GR.				
		MOUNT WORK IN CHUCK	FACE	CENTER	MOUNT BETWEEN CHUCK	TURN	TURN SHOULDER	CUT TAPER W/ TAPER ATTACH	CUT TAPER W/ COMPOUND REST	DRILL	BORE	GROOVE AND NECK	CUT RADIUS	REAM	REAM TAPER	COUNTERSINK	COUNTERBORE	CHAMFER	FORM	KNURL	CUT NAT. STD. THREADS	FILE	POLISH	CUT OFF	GRIND	TAPER BORE	TURN WITH BOX TOOL	CHAMFER	FORM	FACE	CENTER	DRILL	REAM	BORE	THREAD	FILE	NECK	COUNTERSINK	KNURL	CUT OFF	GRIND STRAIGHT HOLE	GRIND TAPERED HOLE	GRIND FACES	DRESS WHEEL	GRIND PLAIN SURFACE	GRIND ANGULAR SURFACE	GRIND SLOT	DRESS WHEEL	STRAIGHT GRIND	TAPER GRIND	GRIND TO SHOULDER	LAP CENTERS	DRESS WHEEL
26	FLAT HD. MACH. SCREW																																																				
27	SPOTFACER BAR																																																				
28	GO & NOGO PLUG GAUGES																																																				
29	PLUG GAUGE HANDLE																																																				
30	TAPER PLUG GAUGE																																																				
31	LATHE CENTER																																																				
32	SPUR CENTER																																																				
33	CUP CENTER																																																				
34	TOOL POST WEDGE																																																				
35	PARALLEL CLAMPS																																																				
36	C-CLAMPS																																																				
37	PLANER JACK																																																				
38	TOOLMAKER'S VISE																																																				
39	CAST IRON GEAR																																																				
40	TAPER RING GAUGE																																																				
41	MORSE TAPER SLEEVE																																																				
42	OIL QUILL																																																				
43	SINGLE POINT SCRIBER																																																				
44	DOUBLE POINT SCRIBER-A																																																				
45	DOUBLE POINT SCRIBER-B																																																				
46	VEE BLOCKS																																																				
47	STANDARD RING GAUGE																																																				
48	TAP WRENCH																																																				
49	RADIUS CUTTER																																																				
50	SURFACE GAUGE																																																				

MACHINE SHOP FLAT HEAD MACHINE SCREW

TURRET LATHE 1

MILLING MACHINE 1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A FLAT HEAD MACHINE SCREW ACCORDING TO SPECIFICATIONS; USING THE NECESSARY MACHINES AND PROCEDURES CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR THE JOB.
3. LAYOUT ACCORDING TO SPECFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

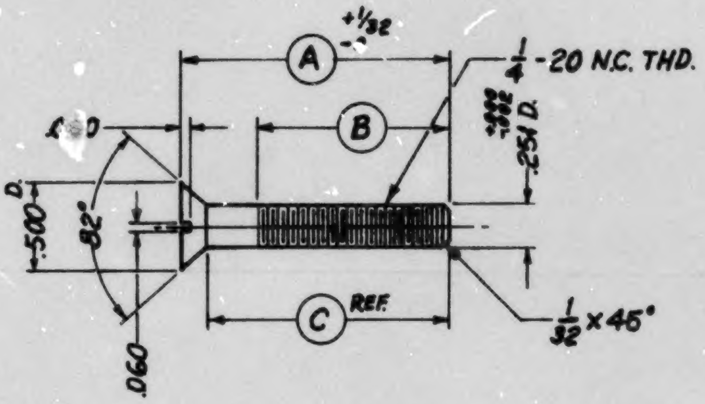
REF. #1, WALKER, JOHN R., MODERN METAL WORKING, GOODHEART-WILLCOX, 123 W. TAFT DRIVE, SOUTH HOLLAND, IL, 60474, 1970, 520 PAGES, $5.97

REF. #2, LUDWIG, OSWALD A., AND WILLARD J. McCARTHY, METALWORK TECHNOLOGY AND PRACTICE, McKNIGHT AND McKNIGHT PUBLISHING COMPANY, BLOOMINGTON, IL, 61701, 1969, 630 PAGES, $6.48

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS, GOODHEART-WILLCOX, 123 W. TAFT DRIVE, SOUTH HOLLAND, IL, 60474, 1969, 512 PAGES, $6.72

NOTE: TASK SHEETS FOR THIS JOB ARE DIMENSIONED FOR REF. #1 OF DRAWING #1. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.

THE NUMBER OF FLAT HEAD SCREWS TO BE MACHINED IN ANY GIVEN SIZE IS LEFT TO THE DISCRETION OF THE INSTRUCTOR.


+1/32
-0
A
1/4-20 N.C. THD.
B
+.000
-.002
.251 D.
.500 D.
82°
.060
C REF.
1/32 × 45°

REF. NO.	A	B	C
1	3/4"	5/8"	5/8"
2	1"	7/8"	7/8"
3	1 1/4	1 1/8"	1 1/8"
4	1 1/2"	1 3/8"	1 3/8"
5	2"	1 3/4"	1 7/8"
6	3"	1 3/4"	2 7/8"

DRAWING NO. 1	*FLAT HEAD MACHINE SCREW*	**TOLERANCES UNLESS OTHERWISE NOTED**
TURRET LATHE JOB NO. 1 *MILLING JOB NO. 1*	**MATERIAL:** *C.R. STEEL* **FINISH:** *TOOL* **SCALE:** *FULL SIZE*	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-A-1(J)

JOB SHEET
IN
TURRET LATHE

JOB:	FLAT HEAD MACHINE SCREW	
MATERIALS:	1/2" DIAMETER COLD ROLLED BAR STOCK	
TOOLS AND EQUIPMENT:	TURRET LATHE FEED FINGERS 1/2: COLLET BOX TURNING TOOL STOCK STOP 0-1" MICROMETER THREAD CHASER	BAR STOCK SUPPORT 1/4"-20 THREADING DIE 45° CHAMFERING TOOL PARTING TOOL 10" MILL FILE THREAD GAUGE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #3, TURRET LATHE, P. 201. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:	VII-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	VII-A-1a(TS)	SET UP TURRET LATHE
	VII-A-1b(TS)	MACHINE WORK PIECE
	VII-A-1c(TS)	CLEAN MACHINE
		ROUTE WORK PIECE TO MILLING MACHINE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, MACHINES, EQUIPMENT, AND STANDARDS.

TASK SHEET VII-A-1(TS)

TASK: CHECK MACHINE FOR PROPER OPERATING CONDITION

JOB: FLAT HEAD MACHINE SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: TURRET LATHE, FEED FINGERS, 1/2" COLLET, BOX TURNING TOOL, STOCK STOP, BAR STOCK SUPPORT, 1/4"-20 THREADING DIE, 45° CHAMFERING TOOL, PARTING TOOL, MILL FILE, 0-1" MICROMETER, THREAD GAUGE, THREAD CHASER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. OIL	1. CHECK COOLANT RESERVOIR TO BE SURE IT IS FILLED TO OPERATING LEVEL 2. OIL ALL OIL CAPS DAILY, ONE OR TWO DROPS IN EACH HOLE 3. APPLY LIGHT FILM OF OIL ON WAYS
2. TURRET	1. CHECK TURRET FOR SMOOTH ROTATION OR INDEXING 2. CHECK TOOL POST TURRET FOR SMOOTH ROTATION OR INDEXING
3. CROSS SLIDE	CROSS SLIDE SHOULD NOT HAVE ANY PLAY OR SLACK
4. BAR STOCK SUPPORT	CHECK BAR STOCK SUPPORT FOR PROPER LOCATION
5. GUARDS	1. CHECK ALL GUARDS FOR PROPER LOCATION 2. CHECK SPLASH GUARD NOTE: SPLASH GUARD MAY BE REMOVED DURING SETUP. IF SO, REPLACE BEFORE STARTING TO WORK

SKETCHES: DRAWING #1: FLAT HEAD MACHINE SCREW

REFERENCES: REF. #3, P. 201

TASK: SET UP TURRET LATHE

JOB: FLAT HEAD MACHINE SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: TURRET LATHE, FEED FINGERS, 1/2" COLLET, BOX TURNING TOOL, STOCK STOP, BAR STOCK SUPPORT, 1/4"-20 THREADING DIE, 45° CHAMFERING TOOL, 10" MILL FILE, 0-1" MICROMETER, THREAD GAUGE, THREAD CHASER, 1/2" DIAMETER COLD ROLLED BAR STOCK

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT MATERIAL	1. 1/2" DIAMETER COLD ROLLED BAR STOCK 2. DEBURR BAR STOCK
2. MOUNT COLLET	1. 1/2" COLLET IN CHUCK 2. POSITION COLLET IN SPINDLE 3. INSERT COLLET INTO COLLET CHUCK NOTE: COLLET NOT TO BE TIGHTTENED AT THIS TIME
3. SET UP BAR STOCK	1. FEED 1/2" BAR STOCK THROUGH STOCK SUPPORT 2. FEED BAR STOCK THROUGH SPINDLE 3. FEED BAR STOCK THROUGH COLLET 4. ALLOW BAR STOCK TO EXTEND 1 1/4" BEYOND COLLET CHUCK 5. TIGHTEN COLLET TO HOLD STOCK SECURELY FOR MACHINING
4. SET UP STOCK STOP	1. MOUNT STOCK STOP ON TURRET FACE #1 2. TIGHTEN BOLTS AND SECURE STOCK STOPS 3. ADJUST TURRET STOP #1 WHERE END OF STOCK STOP IS 1 1/4" FROM FACE OF COLLET
5. SET UP BOX TURNING TOOL	1. MOUNT BOX TURNING TOOL ON TURRET FACE #2

5. SET UP BOX TURNING TOOL (CON'T.)	2. TIGHTEN BOLTS AND SECURE BOX TURNING TOOL 3. ADJUST TURRET STOP #2 TO CUT DIMENSION C OF DRAWING. 5/8" LENGTH 4. ADJUST BOX TURNING TOOL TO CUT .250" DIAMETER AS PER DRAWING
6. SET UP THREADING DIE	1. MOUNT 1/4"-20 THREADING DIE ON TURRET FACE #3 2. TIGHTEN BOLTS AND SECURE THREADING DIE 3. ADJUST TURRET STOP #3 a. THREADING DIE TO THREAD 5/8" LENGTH b. DIMENSION A OF DRAWING
7. SET UP 45° CHAMFERING TOOL	1. SELECT PREGROUND TOOL STEEL WITH FACE GROUND AT 45° ANGLE 2. MOUNT CHAMFERING TOOL IN TOOL POST, POSITION #1, AND TIGHTEN INTO POSITION 3. SET CROSS SLIDE STOP #1, CHAMFER TOOL TO CUT 1/32" DEEP FROM END OF WORK PIECE 4. SET CARRIAGE STOP TO ALLOW CENTER OF TOOL TO BE AT END OF WORK PIECE
8. SET UP FORMING TOOL	1. SELECT PREGROUND TOOL STEEL WITH 41° ANGLE ON FACE NOTE: THIS WILL HOLD 82° INCLUDED ANGLE AS PER DRAWING 2. MOUNT FORMING TOOL IN TOOL POST POSITION #2 AND TIGHTEN INTO POSITION 3. SET CROSS SLIDE STOP #2, ALLOW TOOL TO CUT .125" DEEP 4. SET CARRIAGE STOP #2 TO ALLOW CENTER OF TOOL TO BE 3/4" FROM END OF WORK PIECE AS WITH FURTHERMOST POINT OF TOOL TO BE 3/4" FROM END OF WORK PIECE
9. SET UP CUT-OFF TOOL	1. SELECT SHARP TOOL 2. MOUNT CUT-OFF TOOL IN TOOL POST POSITION #3 AND TIGHTEN INTO POSITION

9. SET UP CUT-OFF TOOL (CON'T.)	NOTE: POINT OF CUT-OFF TOOL MUST BE LEVEL WITH CENTER OF WORK PIECE. SHIM IF NECESSARY 2. SET CARRIAGE STOP #3 WHERE RIGHT SIDE OF CUT-OFF TOOL WILL BE 3/4" FROM END OF WORK PIECE NOTE: THIS IS DIMENSION L AND THICKNESS OF SCREW HEAD ON DRAWING
10. SET FEED AND SPEED	1. SET CROSS FEED TO REMOVE .002" PER REVOLUTION 2. SET SPEED AT 800 RPM 3. REPLACE SPLASH GUARD REMOVED DURING SETUP

SKETCHES: DRAWING #1: FLAT HEAD MACHINE SCREW

REFERENCES: REF. #3, P. 201

TASK SHEET

TASK: MACHINE WORK PIECE

JOB: FLAT HEAD MACHINE SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: TURRET LATHE, FEED FINGERS, 1/2" COLLET, BOX TURNING TOOL, STOCK STOP, BAR STOCK SUPPORT, 1/4"-20 THREADING DIE, 45° CHAMFERING TOOL, 10" MILL FILE, 0-1" MICROMETER, THREAD GAUGE, THREAD CHASER, 1/2" DIAMETER COLD ROLLED BAR STOCK

TASK BREAKDOWN:

STEPS	KEY POINTS
1. TURN DIAMETER	1. PUT GOGGLES ON 2. START MACHINE 3. TURN TURRET TO POSITION #2 4. HAND FEED TURRET TOWARD WORK PIECE UNTIL BOX TURNING TOOL IS ABOUT 1/4" FROM END OF WORK PIECE 5. TURN COOLANT ON 6. ENGAGE AUTOMATIC FEED NOTE: AUTOMATIC FEED WILL DISENGAGE WHEN IT REACHES THE STOP 7. HAND FEED TURRET TO RIGHT END OF TABLE OR STARTING POSITON
2. THREAD	1. REVOLVE TURRET TO POSITION #3 FOR THREADING 2. FEED TURRET BY HAND TOWARD WORK AND STOP AS IN THE PREVIOUS STEP 3. ENGAGE AUTOMATIC FEED AS BEFORE 4. WHEN AUTOMATIC FEED DISENGAGES RETURN TURRET TO STARTING POSITION
3. 45° CHAMFER	1. TURN CARRIAGE STOP TO #1 POSITION 2. HOLD CARRIAGE AGAINST STOP AND TIGHTEN CARRIAGE LOCK BOLT 3. HAND FEED CROSS SLIDE IN UNTIL END OF CHAMFERING TOOL IS 1/4" FROM WORK PIECE

3. 45° CHAMFER (CON'T.)	4. ENGAGE AUTOMATIC FEED IN 5. WHEN AUTOMATIC FEED DISENGAGES TURN CROSS SLIDE HANDLE COUNTER-CLOCKWISE TO BACK TOOL AWAY NOTE: BE SURE TO BACK TOOL AWAY FAR ENOUGH THAT IT WILL NOT HIT WORK PIECE WHEN REVOLVED TO NEXT POSITION 6. UNLOCK CARRIAGE
4. TURN 82° INCLUDED ANGLE	1. TURN CARRIAGE STOP TO #2 POSITION AND LOCK CARRIAGE AS BEFORE 2. REVOLVE TOOL POST TO #2 POSITION TO FORM HEAD ANGLE 3. HAND FEED IN AS IN PREVIOUS STEP 4. ENGAGE AUTOMATIC FEED AS BEFORE 5. RETURN CROSS SLIDE AS BEFORE 6. UNLOCK CARRIAGE
5. CUT-OFF	1. TURN CARRIAGE STOP TO #3 POSITION AND LOCK CARRIAGE AS BEFORE 2. REVOLVE TOOL POST TO #3 POSITION FOR CUT-OFF 3. HAND FEED IN AS IN PREVIOUS STEP 4. ENGAGE AUTOMATIC FEED AS BEFORE NOTE: IF CHATTER OCCURS SLOW SPEED TO 400 RPM 5. WHILE CUT-OFF TOOL IS MAKING ITS CUT, LAY A FILE ON EDGES TO REMOVE BURRS 6. RETURN CROSS SLIDE TO STARTING POSITION AS BEFORE 7. TURN MACHINE AND COOLANT OFF
6. INSPECT	1. .250" DIAMETER 2. 3/4" LENGTH 3. 45° CHAMFER 4. 82° INCLUDED ANGLE 5. THREADS 1/4"-20 6. MAKE NECESSARY ADJUSTMENTS IF PART IS NOT TO DRAWING SPECIFICATIONS

SKETCHES: DRAWING #1 : FLAT HEAD MACHINE SCREW

TASK SHEET

VII-A-1c(TS)

TASK: CLEAN WORK STATION

JOB: FLAT HEAD MACHINE SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH BRUSH, TURRET HAND TOOLS, TOOL POST HAND TOOL, DUSTPAN, BROOM, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE TOOLS	1. REMOVE TOOLS FROM EACH TURRET FACE
	2. REMOVE TOOLS FROM TOOL POST
	3. REMOVE COLLET FROM LATHE
	4. WIPE COLLET AND ALL TOOLS CLEAN
	5. RETURN COLLET AND ALL TOOLS TO STORAGE
2. CLEAN WORK STATION	1. BRUSH CHIPS FROM MACHINE
	2. SWEEP FLOOR
	3. COLLECT CHIPS AND TRASH IN DUSTPAN
	4. DEPOSIT CHIPS AND TRASH IN WASTE CAN
	5. WIPE MACHINE WITH CLEAN RAG

JOB SHEET
IN
MILLING MACHINE

IX-A-1(J)

JOB: FLAT HEAD MACHINE SCREW

MATERIALS: WORK PIECE SHAPED AND THREADED

TOOLS AND EQUIPMENT:
HORIZONTAL MILLING MACHINE 6" RULE
1/16" SLITTING SAW CUTTER
"V" BLOCK AND CLAMP
ARBOR AND COLLARS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, MILLING, PP. 38-1 TO 38-38, REF. #2, MILLING, PP. 524-564. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASK:

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-A-1a(TS)	SET UP MACHINE
IX-A-1b(TS)	MILL SLOT IN WORK PIECE
IX-A-1c(TS)	CLEAN WORK STATION, AS IN PRECEDING TASK

CHECK POINTS:

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

IX-A-1(TS)

TASK: CHECK MACHINE FOR PROPER OPERATING CONDITION

JOB: FLAT HEAD MACHINE SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, ARBOR AND COLLARS, 1/16" SLITTING SAW CUTTER, 6" RULE, "V" BLOCK AND CLAMP

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOTOR	1. PROPER GROUNDING
	2. ON AND OFF SWITCH FUNCTION PROPERLY
2. LUBRICATION	1. OIL OR COOLANT RESERVOIR AT PROPER OPERATING LEVEL
	2. ONE OR TWO DROPS IN EACH OIL HOLE
	3. CHECK WAYS FOR PROPER OILING NOTE: USE OIL CAN IF NECESSARY
3. BELTS	1. IN WORKING CONDITION
	2. PROPER TENSION
4. GUARDS	1. IN PLACE
	2. TIGHTEN IF NECESSARY

SKETCHES: DRAWING #1: FLAT HEAD MACHINE SCREW

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

IX-A-1a(TS)

TASK: SET UP MACHINE

JOB: FLAT HEAD MACHINE SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, ARBOR AND COLLARS, 1/16" SLITTING SAW CUTTER, 6" RULE, "V" BLOCK AND CLASP

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP MILL ARBOR	1. WIPE FEMALE TAPER IN MACHINE HEAD CLEAN
	2. WIPE MILL ARBOR CLEAN
	3. INSERT TAPER END OF ARBOR INTO PROPER PLACE IN MACHINE
	4. HAND SCREW DRAW BAR INTO ARBOR FROM BACK OF MILLING MACHINE NOTE: DRAW BAR THREADS MUST SCREW INTO ARBOR AT LEAST 1"
	5. TIGHTEN DRAW BAR INTO ARBOR WITH PROPER WRENCH NOTE: THE DRAW BAR WILL SECURE THE TAPER ON ARBOR INTO TAPER ON MACHINE NOTE: BE SURE NOTCHES ON ARBOR SHOULDER ARE FITTED OVER HEAD LOCKING KEYS BEFORE TIGHTENING DRAW BAR
	6. UNSCREW NUT FROM END OF ARBOR
2. INSTALL SLITTING CUTTER	1. REMOVE 1/2 THE SPACERS
	2. SLIDE SLITTING CUTTER ONTO ARBOR NOTE: BE SURE DIRECTION OF TEETH WILL PERMIT CUT IN UPWARD ROTATION. SEE REF. #1, PP. 38-22 TO 38-28
	3. INSTALL ALL SPACERS AS BEFORE NOTE: THE LARGE SPACER SHOULD

2. INSTALL SLITTING CUTTER (CON'T.)	BE ABOUT 2" FROM CUTTER. IT WILL FIT INTO OVERARM AND SUPPORT ARBOR 4. SCREW ARBOR NUT BACK ON ARBOR 5. TIGHTEN ARBOR NUT SECURELY
3. SET UP OVERARM	1. LOOSEN OVERARM LOCKING NUTS AT SIDE OF MACHINE 2. PLACE PROPER WRENCH ON OVERARM MOVEMENT NUT 3. TURN WRENCH TO MOVE OVERARM ARBOR 4. TIGHTEN OVERARM LOCKING NUTS
4. SET UP ARBOR SUPPORT	1. SLIDE ARBOR SUPPORT ONTO OVERARM DOWN TAIL NOTCHES NOTE: SLIDE ON UNTIL LARGE SPACER ON ARBOR IS IN CENTER OF HOLE IN ARBOR SUPPORT 2. TIGHTEN ARBOR SUPPORT NUT NOTE: ARBOR MUST REVOLVE FREELY IN ARBOR SUPPORT 3. FILL OILER ON ARBOR SUPPORT WITH PROPER LUBRICATING OIL
5. SET SPEED	1. SEE RECOMMENDED CUTTING SPEEDS, REF. #1, P. 38-16, OR REF. #2, PP. 549-550 2. SET MACHINE SPEED TO ABOUT 80' PER MINUTE
6. SET FEED	SET FEED ON MACHINE TO .050" PER REVOLUTION
7. SET TABLE STOP	1. LOOSEN STOP NUTS ON TABLE 2. ADJUST STOPS TO SHUT OFF AUTOMATIC FEED AFTER CUTTER CLEARS END OF WORK PIECE BY 1/4" 3. TIGHTEN STOP NUTS
8. TABLE LOCK NUTS	LOOSEN ALL TABLE LOCKING NUTS
9. SET UP VISE	1. WIPE MILL TABLE CLEAN 2. WIPE BOTTOM OF VISE CLEAN 3. SET VISE ON MILL TABLE 4. POSITION VISE WHERE JAWS ARE PARALLEL TO TABLE AND CENTERED ON TABLE

9.	SET UP VISE (CON'T.)	5.	INSTALL PROPER "T" BOLTS IN SLOT ON MILL TABLE
		6.	SLIDE "T" BOLTS TOWARD CENTER OF TABLE AND INTO SLOTS ON SIDE OF VISE
		7.	SCREW HEX NUTS ON "T" BOLTS
		8.	SNUG NUTS DOWN
10.	INDICATE VISE TRUE (OPTIONAL)	1.	ATTACH DIAL INDICATOR ON COLUMN OF ARBOR
		2.	OPEN VISE JAWS ABOUT THREE OR FOUR INCHES
		3.	SET DIAL INDICATOR TO INDICATE VISE TRUE
		4.	INDICATE VISE TRUE
		5.	TIGHTEN VISE LOCKING NUTS ON "T" BOLTS
11.	SET UP "V" BLOCK	1.	SET "V" BLOCK IN VISE WITH "V" TOWARD LEFT END OF TABLE NOTE: BE SURE "V" BLOCK IS STRAIGHT IN VISE
		2.	TIGHTEN VISE

SKETCHES: DRAWING #1: FLAT HEAD MACHINE SCREW

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET IX-A-1b(TS)

TASK: MILL SLOT IN WORK PIECE

JOB: FLAT HEAD MACHINE SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, ARBOR AND COLLARS, 1/16" SLITTING SAW CUTTER, 6" RULE, "V" BLOCK AND CLAMP

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK PIECE	1. PLACE MACHINED SCREW IN "V" BLOCK WITH LARGE END UP AND START OF TAPER ON TOP OF BLOCK
	2. INSTALL "V" BLOCK CLAMP IN SLOTS ON "V" BLOCK
	3. ADJUST CLAMP AS NEAR SCREW HEAD AS POSSIBLE
	4. TIGHTEN "V" BLOCK CLAMP NOTE: SHIM STOCK SHOULD BE USED BETWEEN SCREW ON "V" BLOCK AND THREADS ON WORK PIECE TO PREVENT DAMAGE TO THREADS
2. SET SLITTING CUTTER POSITION	1. PUT GOGGLES ON
	2. TURN MACHINE ON NOTE: BE SURE CUTTER IS REVOLVING IN PROPER DIRECTION SEE REF. #1, PP. 38-22 TO 38-28
	3. MOVE TABLE LONGITUDINAL, CROSS, AND ELEVATION HANDLES TO POSITION SIDE OF CUTTER NEAR SIDE OF SCREW NEAREST YOU.
	4. HOLD A PIECE OF PAPER BETWEEN CUTTER AND WORK PIECE
	5. MOVE TABLE OUT SLOWLY UNTIL CUTTER CUTS PAPER
	6. TURN TABLE ELEVATION HANDLE COUNTERCLOCKWISE TO LOWER TABLE UNTIL BOTTOM OF CUTTER IS BELOW TOP OF WORK PIECE

2. SET SLITTING CUTTER POSITION (CON'T.)	7. MOVE TABLE OUT EXACTLY .281" BY THE DIAL
	8. LOCK TABLE CROSS SLIDE
	9. TURN TABLE ELEVATION HANDLE CLOCKWISE TO RAISE TABLE UNTIL CUTTER JUST TOUCHES WORK PIECE
	10. TURN TABLE LONGITUDINAL HANDLE TO MOVE TABLE UNTIL WORK PIECE IS 1/2" AWAY FROM CUTTER NOTE: BE SURE CUTTER WILL CUT IN PROPER DIRECTION. SEE REF. #1, PP. 38-22 TO 38-28
	11. TURN ELEVATION HANDLE TO RAISE TABLE EXACTLY .060" ACCORDING TO THE DIAL
	12. LOCK TABLE ELEVATION
3. MILL SLOT	1. TURN COOLANT ON
	2. ENGAGE AUTOMATIC FEED NOTE: AUTOMATIC FEED WILL DISENGAGE ITSELF AT THE TABLE STOP
4. REMOVE WORK	1. TURN COOLANT OFF
	2. TURN MACHINE OFF
	3. REMOVE WORK PIECE FROM "V" BLOCK
5. DEBURR	1. REMOVE MACHINE BURRS WITH FILE
	2. WIPE CLEAN
6. INSPECT	1. SLOT CENTERED THROUGH HEAD
	2. .050" - .070" WIDTH
	3. .053" - .073" DEPTH
7. FINAL ADJUSTMENT	1. IF ANY DIMENSIONS ARE NOT CORRECT MAKE NECESSARY ADJUSTMENTS
	2. CONTINUE TO MACHINE SLOT IN ALL PARTS
8. CLEAN UP MILL	1. REMOVE CUTTERS, CLEAN, AND RETURN TO PROPER PLACE
	2. REMOVE ARBOR, CLEAN, AND STORE
	3. REMOVE ALL CHIPS WITH BRUSH
	4. WIPE MACHINE CLEAN
	5. DISPOSE OF WASTE

SKETCHES: DRAWING #1: FLAT HEAD MACHINE SCREW

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

MACHINE SHOP SPOTFACER BAR

ENGINE LATHE	1
MILLING MACHINE	2
CYLINDRICAL GRINDER	1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWING, AND MACHINE A SPOTFACER BAR ACCORDING TO SPECIFICATIONS; USING THE NECESSARY MACHINES AND PROCEDURES CALLED FOR IN THE JOB.

CHECKING STANDARDS

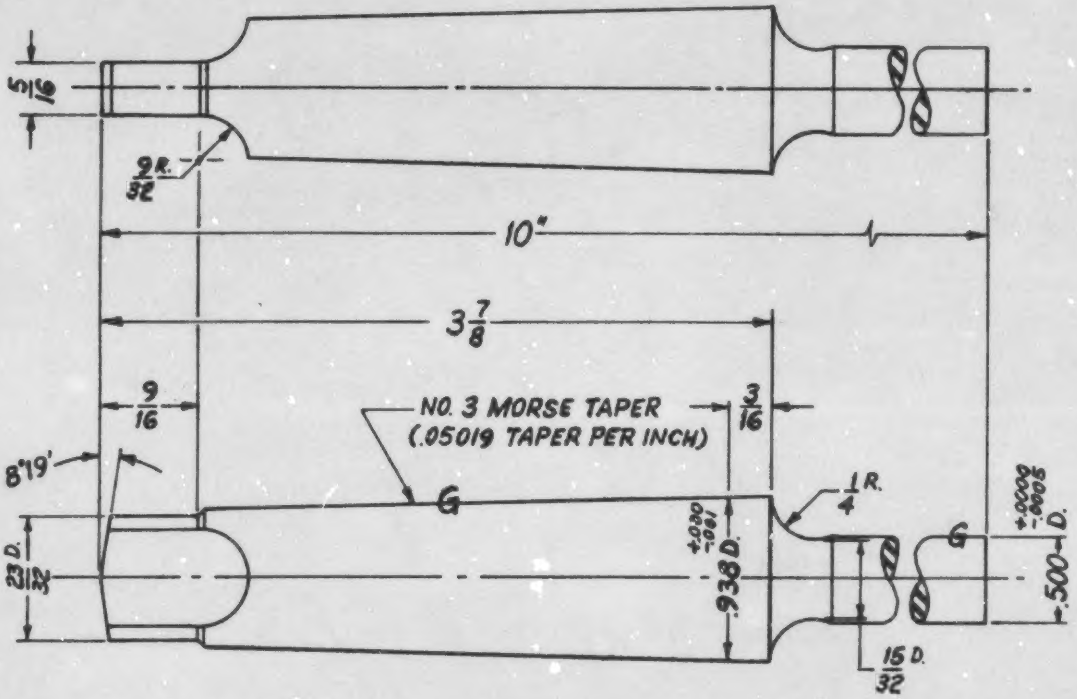
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR THE JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
8. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A., AND WILLIAM J. McCARTHY, METAL TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS


5/16
9/32 R.
10"
3 7/8
9/16
NO. 3 MORSE TAPER
(.05019 TAPER PER INCH)
3/16
8°19'
1/4 R.
G
23/32 D.
+.020
-.001
.938 D.
G
+.0000
-.0005
.500 D.
15/32 D.

ALLOW .020" FOR GRINDING

DRAWING NO. 2	SPOTFACER BAR	TOLERANCES UNLESS OTHERWISE NOTED
ENGINE LATHE JOB NO. 1 MILLING JOB NO. 2 CYL. GRINDER JOB NO. 1	MATERIAL: TOOL STEEL FINISH: GRIND SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-B-1(J)

JOB SHEET
IN
ENGINE LATHE

JOB: SPOTFACER BAR

MATERIALS: 1" X 10 1/4" TOOL STEEL
240 GRIT EMERY CLOTH

TOOLS AND EQUIPMENT:
ENGINE LATHE
COLLET ATTACHMENT
1" COLLET
1/2" COLLET
1/4" RADII TOOL
TURNING TOOLS WITH RIGHT HAND TOOL
DIAL INDICATOR
0-1" MICROMETER
10" MILL FILE
12" RULE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHE, PP. 36-1 TO 36-44, AND REF. #2, LATHE, PP. 462-494. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:	VII-B-1(TS)	CHECK MACHINE FOR PROPER RUNNING CONDITION.
	VII-B-1a(TS)	SET UP LATHE.
	VII-B-1b(TS)	FACE ONE END OF WORK PIECE.
	VII-B-1c(TS)	SET UP AND TURN 8°19' ANGLE.
	VII-B-1d(TS)	SET UP AND TURN 23/32" DIAMETER.
	VII-B-1e(TS)	SET UP AND TURN 1/2" DIAMETER.
	VII-B-1f(TS)	SET UP AND TURN 1/4" RADII.
	VII-B-1g(TS)	SET UP AND TURN #3 MORSE TAPER.
ALTERNATE	VII-B-1h(TS)	SET UP AND TURN #3 MORSE TAPER.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUPS.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET VII-B-1(TS)

TASK: CHECK ENGINE LATHE FOR PROPER RUNNING CONDITION

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 1" COLLET, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, 1/4" RADII TOOL, DIAL INDICATOR, 0-1" MICROMETER, MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LUBRICATION	1. OIL DAILY
	2. ONE OR TWO DROPS IN EACH OIL HOLE
	3. CLEAN AND OIL WAYS
	4. FILL OIL RESERVOIRS TO PROPER LEVEL NOTE: MOST MACHINES HAVE GLASS WINDOWS WITH CROSS MARK FOR PROPER LEVEL
2. CARRIAGE AND COMPOUND REST	1. LOOSEN CARRIAGE LOCK BOLT
	2. CARRIAGE, CROSS SLIDE, AND COMPOUND REST SHOULD MOVE FREELY WHEN TURNED BY HAND WHEELS
	3. ADJUST COMPOUND REST FOR PROPER OVERHAND
3. GUARDS	1. ALL GUARDS IN POSITION
	2. TIGHTEN IF NECESSARY

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 36-8
REF. #2, P. 465

TASK SHEET

VII-B-1a(TS)

TASK: SET UP LATHE

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: 1" X 10 1/4" TOOL STEEL, POWER HACKSAW, CUTTING OIL, ENGINE LATHE, COLLET ATTACHMENT, 1" COLLET, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, 1/4" RADII TOOL, DIAL INDICATOR, 0-1" MICROMETER, 10" MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT MATERIAL	1. SOME TYPE OF TOOL STEEL MUST BE USED, CHECK WITH INSTRUCTOR
	2. 1" DIAMETER TOOL STEEL
2. SAW STOCK	1. POSITION MATERIAL IN SAW
	2. MEASURE AND MARK STOCK 10 1/4"
	3. CLAMP STOCK
	4. TURN ON COOLANT OR OIL
	5. SAW STOCK
	6. TURN OFF SAW AND COOLANT
	7. REMOVE STOCK FROM SAW
	8. CLEAN SAW AND WORK AREA
	9. DEBURR WORK PIECE WITH 10" MILL FILE
3. INSTALL 1" COLLET	1. WIPE LATHE HEAD STOCK THREADS CLEAN
	2. SCREW NOSE CAP ON SPINDLE
	3. INSERT COLLET SLEEVE IN SPINDLE
	4. INSERT COLLET INTO SLEEVE
	5. INSERT DRAW BAR THROUGH HEAD STOCK FROM LEFT END
	6. HAND SCREW DRAW BAR INTO COLLET. DO NOT TIGHTEN NOTE: THERE ARE MANY TYPES OF COLLETS AND COLLET ATTACHMENTS, SEE REF. #1, P. 36-22

4. MOUNT WORK PIECE	1. PLACE ONE END OF WORK PIECE IN COLLET 2. LEAVE 1/2" OF WORK PIECE EXPOSED 3. TIGHTEN DRAW BAR BY HAND
5. SELECT LATHE CUTTING TOOL	1. STANDARD RIGHT HAND TURNING TOOL 2. TOOL TO BE SHARP
6. SET UP CUTTING TOOL	1. USE RIGHT HAND TOOL HOLDER 2. LOOSEN TOOL HOLDER SCREW 3. SLIDE RIGHT HAND TOOL INTO HOLDER CUTTING END AWAY FROM TAIL OF HOLDER 4. CUTTING END TO EXTEND 1/2" OUTSIDE OF TOOL HOLDER HEAD 5. USE TOOL HOLDER WRENCH AND TIGHTEN TOOL INTO POSITION
7. SET UP TOOL HOLDER	1. PLACE TAIL OF TOOL HOLDER INTO TOOL POST 2. CUTTING END OF TOOL FACING WORK PIECE 3. ADJUST TOOL POST ANGLE TO SET CUTTING TOOL FOR FACING WORK PIECE 4. TIGHTEN TOOL POST AND TOOL HOLDER INTO POSITION WITH TOOL POST WRENCH
8. LOCK TABLE	1. USE CARRIAGE LOCKING BOLT WRENCH 2. TIGHTEN CARRIAGE LOCKING BOLT
9. SET LATHE FEED AND SPEED	1. SEE CHART, REF. #1, P. 36-14 2. SEE CHART, REF. #2, P. 550

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 36-14 TO 36-24
REF. #2, P. 479

TASK SHEET

VII-B-1b(TS)

TASK: FACE ONE END OF WORK PIECE

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 1" COLLET, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, 1/4" RADII TOOL, DIAL INDICATOR, 0-1" MICROMETER, MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FACE END	1. PUT GOGGLES ON 2. START MACHINE 3. TURN CARRIAGE AND CROSS SLIDE HAND WHEELS UNTIL TOOL POINT IS IN PROPER POSITION FOR FACING 4. FACE END OF WORK PIECE TO MINIMUM CLEAN UP 5. LOOSEN CARRIAGE LOCKING BOLT
2. DEBURR	1. REMOVE SHARP EDGE WITH FILE WHILE WORK IS ROTATING 2. REMOVE WORK PIECE FROM MACHINE

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 36-14 TO 36-24
REF. #2, P. 479

TASK SHEET

TASK:	SET UP AND TURN 8° 19' ANGLE
JOB:	SPOTFACER BAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, COLLET ATTACHMENT, 1" COLLET, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, 1/4" RADII TOOL, DIAL INDICATOR, 0-1" MICROMETER, MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT	LAYOUT 10" LENGTH FROM FINSIHED END
2. SET UP WORK PIECE	1. PLACE WORK PIECE IN COLLET WITH LAYOUT END PROTRUDING 1" FROM COLLET FACE 2. TIGHTEN COLLET DRAW BAR
3. SET UP COMPOUND REST	1. LOOSEN LOCKING NUTS ON COMPOUND 2. TURN COMPOUND REST TO 8° 19' NOTE: THE 19' WILL HAVE TO BE ESTIMATED. THIS IS APPROXIMATELY 1/3 OF ANOTHER DEGREE NOTE: HANDLE MUST BE TOWARD HEADSTOCK 3. TIGHTEN COMPOUND REST LOCKING NUTS
4. POSITION TOOL	1. TURN CARRIAGE AND CROSS SLIDE HAND WHEELS UNTIL TOOL IS IN PROPER POSITION FOR FACING NOTE: COMPOUND REST MUST BE BACKED OUT 1" FROM INNERMOST POINT CAUTION: BE SURE THERE IS CLEARANCE BETWEEN COMPOUND REST AND COLLET 2. TIGHTEN CARRIAGE LOCKING BOLT

5. TURN ANGLE	1. FACE END OF WORK PIECE USING COMPOUND REST TO LAYOUT LINE 2. HOLD 10" LENGTH 3. STOP MACHINE

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, P. 26-25
REF. #2, PP. 478-479

TASK SHEET

VII-B-1d(TS)

TASK: SET UP AND TURN 23/32" DIAMETER

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 1" COLLET, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, 1/4" RADII TOOL, DIAL INDICATOR, 0-1" MICROMETER, MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOVE CARRIAGE	1. LOOSEN CARRIAGE LOCKING BOLT 2. MOVE CARRIAGE AWAY FROM HEADSTOCK
2. SET COMPOUND REST	1. LOOSEN COMPOUND REST LOCKING NUTS 2. SET COMPOUND REST AT STANDARD POSITION NOTE: SOME TEXTBOOKS INDICATE 30° OTHERS 29°. CHECK WITH INSTRUCTOR 3. TIGHTEN COMPOUND REST LOCKING NUTS
3. SET UP TURNING TOOL	1. LOOSEN TOOL POST 2. REPOSITION TOOL FOR TURNING TO A SHOULDER 3. TIGHTEN TOOL POST
4. POSITION TOOL	TURN CARRIAGE AND CROSS SLIDE HAND WHEELS UNTIL CUTTING TOOL IS IN PROPER POSITION FOR TURNING
5. TURN 23/32" DIAMETER	1. TURN MACHINE ON 2. TURN 23/32" DIAMETER 3. HOLD 9/16" LENGTH
6. DEBURR	HOLD FILE ON ROTATING WORK PIECE SHOULD TO REMOVE SHARP EDGE

7. REMOVE WORK PIECE	1. TURN MACHINE OFF 2. LOOSEN COLLET DRAW BAR 3. REMOVE WORK PIECE

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 36-15 TO 36-19
REF. #2, P. 482

TASK SHEET VII-B-1e(TS)

TASK: SET UP AND TURN 1/2" DIAMETER

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 1" COLLET, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, 1/4" RADII TOOL, DIAL INDICATOR, 0-1" MICROMETER, MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK PIECE	1. PLACE WORK PIECE IN COLLET, SHOULDER END IN MACHINE, AND EXTENDING OUT 6 1/2" FROM FACE OF COLLET 2. TIGHTEN COLLET DRAW BAR
2. POSITION TOOL	TURN CARRIAGE AND CROSS SLIDE HAND WHEELS UNTIL CUTTING TOOL IS IN PROPER POSITION FOR TURNING DIAMETER
3. TURN .500" DIAMETER	1. TURN MACHINE ON 2. TURN 1/2" DIAMETER AND HOLD 5 3/4" LENGTH FROM END OF WORK PIECE NOTE: THE 5 3/4" LENGTH MUST BE HELD TO PROTECT 1/4" RADII. THE 6 1/4" LENGTH WILL BE HELD LATER NOTE: ALLOW .020" FOR GRINDING. HOLD .520" DIAMETER 3. TURN MACHINE OFF

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 36-15 TO 36-19
REF. #2, P. 483

TASK SHEET VII-B-1f(TS)

TASK: SET UP AND TURN 1/4" RADII

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 1" COLLET, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, 1/4" RADII TOOL, DIAL INDICATOR, 0-1" MICROMETER, MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TOOL	1. TURN CROSS SLIDE HAND WHEEL COUNTERCLOCKWISE TO BACK TOOL AWAY FROM WORK PIECE 2. REMOVE CUTTING TOOL FROM TOOL HOLDER 3. INSERT RADII TOOL IN TOOL HOLDER 4. TIGHTEN TOOL IN HOLDER NOTE: THIS TOOL SHOULD BE 1/2" WIDE WITH SPHERICAL RADIUS GROUND ON END
2. ADJUST TOOL POST	1. LOOSEN TOOL POST 2. TURN TOOL UNTIL IT IS PERPENDICULAR TO WORK PIECE 3. TIGHTEN TOOL POST
3. POSITION TOOL POST	1. TURN CARRIAGE AND CROSS SLIDE HAND WHEELS UNTIL LEFT SIDE OF CUTTING TOOL IS 6 1/8" FROM END OF WORK PIECE 2. TIGHTEN CARRIAGE LOCKING BOLT
4. SET RPM	SET MACHINE IN BACKGEAR
5. TURN 1/4" RADII	1. HAND FEED CROSS SLIDE INTO WORK PIECE SLOWLY 2. HOLD 15/32" DIAMETER WITH A CALIPER NOTE: A MICROMETER WILL NOT GIVE

5. TURN 1/4" RADII (CON'T.)		AN ACCURATE MEASUREMENT AS THERE IS NOT FLAT SURFACE
6. DEBURR		REMOVE BURRS WITH A FILE WHILE ROTATING
7. REMOVE WORK PIECE	1.	TURN MACHINE OFF
	2.	LOOSEN COLLET DRAW BAR
	3.	REMOVE WORK PIECE

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #3, P. 163

TASK SHEET

TASK: SET UP AND TURN #3 MORSE TAPER

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, DIAL INDICATOR, 0-1" MICROMETER, MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHANGE COLLETS	1. REMOVE 1" COLLET 2. INSERT 1/2" COLLET AS BEFORE
2. SET UP WORK PIECE	1. INSERT WORK PIECE INTO COLLET AS FAR AS POSSIBLE 2. TIGHTEN COLLET DRAW BAR
3. SET RPM	1. TAKE MACHINE OUT OF BACKGEAR 2. SEE CHART REF. #1, P. 36-14 AND REF. #2, P. 468
4. SET UP TURNING TOOL	1. LOOSEN CARRIAGE LOCKING BOLT 2. REMOVE RADII TOOL FROM TOOL HOLDER 3. INSERT TURNING TOOL 4. TIGHTEN TURNING TOOL IN HOLDER
5. SET UP COMPOUND REST	NOTE: TAPERS MAY BE TURNED BY THREE DIFFERENT METHODS. CONFER WITH INSTRUCTOR. THE FOLLOWING TASK BREAKDOWN SHEETS ARE DESIGNED FOR TURNING TAPER WITH COMPOUND REST 1. LOOSEN LOCKING NUTS ON COMPOUND REST 2. SET COMPOUND REST ON 2° 58' WITH HAND WHEEL TOWARD TAILSTOCK END OF LATHE AND TOWARD BACK SIDE OF LATHE

5. SET UP COMPOUND REST (CON'T.)	3. SNUG LOCKING NUTS 4. ATTACH DIAL INDICATOR TO TOOL HOLDER 5. INDICATE .05019" PER INCH NOTE: IT WILL BE NECESSARY TO TAP SIDE OF COMPOUND REST LIGHTLY TO OBTAIN EXACT TAPER PER INCH 6. TIGHTEN COMPOUND REST LOCKING NUTS 7. BACK COMPOUND REST OUT AS FAR AS POSSIBLE WITH HAND WHEEL
6. POSITION TOOL	1. TURN CARRIAGE AND CROSS SLIDE HAND WHEELS TO POSITION CUTTING TOOL AT THE SHOULDER OF WORK PIECE AND READY TO TURN 2. TIGHTEN CARRIAGE LOCKING BOLT 3. IT MAY BE NECESSARY TO LOOSEN TOOL POST AND RESET POSITION OF CUTTING TOOL
7. TURN TAPER	1. TURN MACHINE ON 2. TAKE CUT ABOUT .075" DEEP 3. STOP MACHINE 4. MEASURE A 1" DISTANCE ON WORK PIECE AND MARK 5. MAKE BOTH ENDS OF MARK TO CHECK FOR PROPER TAPER NOTE: CHECK WITH INSTRUCTOR ON HOW TO MEASURE WITH MICROMETERS ON AN ANGLE. THE LEFT EDGE OF ANVIL AND SPINDLE OF MICROMETERS MUST BE ON MARKS 6. CONTINUE CUTTING UNTIL .938" DIAMETER, 3/16" FROM END IS HELD ACCORDING TO DRAWING
8. DEBURR	1. BREAK ALL SHARP EDGES 2. TURN MACHINE OFF 3. REMOVE WORK PIECE
9. INSPECT	1. .500" DIAMETER 2. 23.32" DIAMETER 3. 6 1/8" LENGTH 4. 3 7/8" LENGTH 5. 15/32" DIAMETER

9. INSPECT (CON'T.)	6. .938" DIAMETER 7. TAPER
10. CLEAN MACHINE	1. REMOVE CHIPS WITH BRUSH 2. WIPE MACHINE OFF 3. RETURN ALL TOOLS TO THEIR PROPER PLACE 4. DISPOSE OF WASTE

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 172-178

TASK SHEET VII-B-1h(TS)

TASK:	OPTIONAL #3 MORSE TAPER, TAPER ATTACHMENT
JOB:	SPOTFACER BAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, COLLET ATTACHMENT, 1/2" COLLET, TURNING TOOLS WITH RIGHT HAND TOOL, DIAL INDICATOR, 0-1" MICROMETER, 10" MILL FILE, 12" RULE, 240 GRIT EMERY CLOTH, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK	REPEAT STEPS 1-4 OF TASK VII-B-1g(TS)
2. SET COMPOUND REST	1. LOOSEN COMPOUND REST LOCKING NUTS 2. SET COMPOUND REST SQUARE WITH WORK AT STANDARD STRAIGHT TURNING POSITION 3. TIGHTEN COMPOUND REST LOCKING NUTS
3. SET UP TAPER ATTACHMENT	1. LOOSEN CROSS SLIDE TO TAPER ATTACHMENT BINDING SCREWS 2. LOOSEN TAPER ATTACHMENT TO WAYS ATTACHING SCREWS 3. SLIDE TAPER ATTACHMENT INTO POSITION TO CUT FULL LENGTH OF TAPER 4. LOCK TAPER ATTACHMENT TO WAYS 5. SET TAPER ATTACHMENT FOR #3 MORSE TAPER NOTE: CHECK WITH INSTRUCTOR AS TAPER ATTACHMENTS VARY IN SETTINGS, SOME ARE GRADUATED IN TAPER PER FOOT AS INCLUDED ANGLE 6. TIGHTEN CROSS SLIDE TO TAPER ATTACHMENT BINDING SCREWS 7. RECHECK TAPER ATTACHMENT TAPER ANGLE
4. COMPLETE TASK	1. MOVE CARRIAGE UNTIL CUTTING TOOL IS NEAR END OF WORK PIECE

NOTE: ABOUT 1" TO THE RIGHT OF WORK PIECE WILL ALLOW ANY SLACK IN MACHINE TO BE TAKEN OUT PRIOR TO START OF CUT

2. REPEAT STEPS 6-10 OF TASK EL-1-8

ROUTE TO VERTICAL MILLING MACHINE

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 172-178

IX-B-1(J)

JOB SHEET
IN
VERTICAL MILLING MACHINE

JOB: SPOTFACER BAR

MATERIALS: MACHINED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:

VERTICAL MILLING MACHINE
9/16" END MILL WITH SPHERICAL RADIUS
MILLING MACHINE JACK
DIVIDING HEAD
ALLEN WRENCH SET
END MILL HOLDER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, MILLS, PP. 38-1 TO 38-38, REF. #2, MILLS, PP. 524-564. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURE AND/OR TASKS:

IX-A-1(TS)	CHECK MACHINE FOR PROPER RUNNING CONDITION.
IX-B-1(TS)	SET UP DIVIDING HEAD.
IX-B-1a(TS)	SET UP WORK PIECE.
IX-B-1b(TS)	SET UP END MILL HOLDER AND END MILL.
IX-B-1c(TS)	MACHINE ONE SIDE OF TANG.
IX-B-1d(TS)	MACHINE SECOND SIDE OF TANG.
	ROUTE TO CYLINDRICAL GRINDER.

CHECK POINTS: STUDENT TO CONFER WTIH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER RUNNING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK:	SET UP DIVIDING HEAD
JOB:	SPOTFACER BAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	VERTICAL MILLING MACHINE, DIVIDING HEAD, ALLEN WRENCH SET, END MILL HOLDER, 9/16" END MILL WITH SPHERICAL RADIUS, MILLING MACHINE JACK, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT DIVIDING HEAD	1. WIPE TABLE CLEAN
	2. WIPE BOTTOM OF DIVIDING HEAD CLEAN
	3. SET DIVIDING HEAD ON RIGHT END OF MILL TABLE WITH CHUCK POINTING TOWARD LEFT END
	4. BOLT DIVIDING HEAD TO TABLE WITH "T" BOLTS ONLY SNUG
2. TRUE DIVIDING HEAD	1. OBTAIN A ROUND STRAIGHT PIECE OF METAL ABOUT 6" LONG
	2. PLACE METAL IN DIVIDING HEAD WITH ABOUT 3" PROTRUDING
	3. TIGHTEN UNIVERSAL CHUCK NOTE: ANY DIAMETER MATERIAL WILL BE SUFFICIENT TO TRUE DIVIDING HEAD
	4. ATTACH DIAL INDICATOR TO COLUMN OR CUTTER HOLDER
	5. INDICATE SIDE OF MATERIAL TRUE IN SAME MANNER AS INDICATING A VISE
	6. TIGHTEN "T" BOLT NUTS
	7. REMOVE MATERIAL FROM DIVIDING HEAD

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #2, P. 536
REF. #3, PP. 256-257

TASK SHEET

TASK: SET UP WORK PIECE

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, DIVIDING HEAD, ALLEN WRENCH SET, END MILL HOLDER, 9/16" END MILL WITH SPHERICAL RADIUS, MILLING MACHINE JACK, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK WORK PIECE	1. PLACE WORK PIECE IN UNIVERSAL CHUCK AS FAR AS POSSIBLE, 1/2" DIAMETER END IN CHUCK 2. TIGHTEN CHUCK WITH CHUCK WRENCH
2. SET JACK	1. PLACE MILLING MACHINE JACK UNDER END OF WORK PIECE TO BE CUT 2. ADJUST JACK TO BE ONLY SNUG AGAINST WORK PIECE NOTE: TOO MUCH PRESSURE ON JACK WILL BOW WORK PIECE NOTE: A "T" BOLT WITH NUT MAY SERVE AS JACK. SEE INSTRUCTOR IF NECESSARY

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #2, P. 536
REF. #3, PP. 256-257

TASK SHEET IX-B-1b(TS)

TASK: SET UP END MILL HOLDER AND END MILL

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, DIVIDING HEAD, ALLEN WRENCH SET, END MILL HOLDER, 9/16, END MILL WITH SPHERICAL RADIUS, MILLING MACHINE JACK, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP END MILL HOLDER	1. WIPE FEMALE TAPER IN MACHINE HEAD CLEAN 2. WIPE 1/2" END MILL HOLDER CLEAN 3. INSERT TAPERED END OF HOLDER INTO TAPERED MACHINE HEAD 4. SCREW DRAW BAR INTO END MILL HOLDER NOTE: DRAW BAR THREADS MUST SCREW AT LEAST 1" INTO HOLDER 5. TIGHTEN DRAW BAR INTO HOLDER WITH WRENCH
2. SET UP END MILL	1. PLACE 1/2" SHANK OF 9/16" END MILL INTO HOLDER 2. TIGHTEN END MILL IN HOLDER WITH PROPER ALLEN WRENCH NOTE: BE SURE SET SCREW IS LOCATED ON FLAT OF END MILL BEFORE TIGHTENING

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 38-9 TO 38-10, AND 38-30 TO 38-32
REF. #2, PP. 545, AND 555-562

TASK SHEET

IX-B-1c(TS)

TASK: MACHINE ONE SIDE OF TANG

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, DIVIDING HEAD, ALLEN WRENCH SET, END MILL HOLDER, 9/16" END MILL WITH SPHERICAL RADIUS, MILLING MACHINE JACK, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET MACHINE SPEED AND FEED	SEE CHART, REF. #1, P. 38-16 OR REF. #2, PP. 549-550
2. POSITION END MILL	1. PUT GOGGLES ON 2. TURN MACHINE ON 3. TURN ELEVATION HANDLE, TABLE, AND CROSSFEED HAND WHEELS TO POSITION END MILL OVER END TO BE CUT
3. CUT 9/32" RADII	1. RAISE TABLE SLOWLY UNTIL END MILL TOUCHES WORK PIECE 2. TURN TABLE LONGITUDINAL HAND WHEEL UNTIL END MILL TOUCHES SHOULDER ON WORK PIECE 3. SET TABLE DIAL ON "O" AND LOCK 4. TURN CROSSFEED HAND WHEEL COUNTERCLOCKWISE UNTIL END MILL IS CLEAN OF WORK PIECE 5. TURN TABLE LONGITUDINAL HAND WHEEL SLOWLY .281" ACCORDING TO THE DIAL NOTE: THIS WILL CUT 9/32" RADII AS PER DRAWING 6. LOCK LONGITUDINAL LOCK 7. ENGAGE AUTOMATIC FEED IN 8. WHEN CUTTER HAS COMPLETED CUT DISENGAGE AUTOMATIC FEED

4. CUT TANG FLAT

1. TURN CROSSFEED HAND WHEEL COUNTERCLOCKWISE UNTIL CUTTER IS OFF WORK AT BACK SIDE AS IT WAS PRIOR TO PREVIOUS CUT
2. RAISE TABLE .050" AND REPEAT SAME PROCEDURE
   NOTE: THERE IS .200" TO BE REMOVED FROM EACH SIDE. THIS WILL REQUIRE FOUR CUTS OF .050" EACH
3. WHEN .200" HAS BEEN REMOVED MOVE TABLE OUT UNTIL CUTTER IS AT THE STARTING POINT
4. LOOSEN TABLE LOCK
5. TURN LONGITUDINAL HAND WHEEL TO REPOSITION END MILL FOR NEXT SERIES OF CUTS
6. LOWER TABLE .150". THIS WILL LEAVE .050" FOR CUT
7. REPEAT SAME PROCEDURES UNTIL ENTIRE END HAS BEEN MACHINED FLAT
   NOTE: THERE ARE SEVERAL METHODS THAT MAY BE USED TO MACHINE TANG. IF IN DOUBT CHECK WITH INSTRUCTOR
   CAUTION: BEFORE REVOLVING WORK PIECE BE SURE CUTTER IS AT LEAST 1" AWAY FROM TANG SO IT WILL NOT CUT INTO IT DURING RESET UP

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 38-20 TO 38-21
REF. #2, PP. 555-562

TASK SHEET

IX-B-1d(TS)

TASK:	SET UP AND MILL SECOND SIDE OF TANG
JOB:	SPOTFACER BAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	VERTICAL MILLING MACHINE, DIVIDING HEAD, ALLEN WRENCH SET, END MILL HOLDER, 9/16" END MILL WITH SPHERICAL RADIUS, MILLING MACHINE JACK, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. RESET DIVIDING HEAD	REVOLVE WORK PIECE 180 DEGREES BY TURNING DIVIDING HEAD HANDLE EXACTLY TWENTY TURNS
2. RESET JACK	RESET JACK AS BEFORE
3. MILL SECOND SIDE OF TANG	1. REPEAT SAME PROCEDURE ON SECOND SIDE OF TANG 2. HOLD 5/16" THICKNESS 3. TURN MACHINE OFF
4. DEBURR	REMOVE MACHINE BURRS WITH FILE
5. CLEAN MILL	1. REMOVE CHIPS WITH BRUSH 2. WIPE MACHINE OFF 3. RETURN ALL TOOLS TO PROPER PLACE 4. DISPOSE OF WASTE

ROUTE TO CYLINDRICAL GRINDER

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 38-20 TO 38-21
REF. #2, PP. 555-562

X-A-1(J)

JOB SHEET
IN
CYLINDRICAL GRINDER

JOB: SPOTFACER BAR

MATERIALS: MACHINED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:
CYLINDRICAL GRINDER DIAMOND WHEEL DRESSER
DIAMOND WHEEL DRESSER
PROPER ABRASIVE WHEEL CHECK
WITH INSTRUCTOR
COOLANT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, GRINDING, PP. 33-1 TO 33-15, REF. #2, GRINDING, PP. 565-582. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASK:

X-A-1(TS)	CHECK MACHINE FOR PROPER RUNNING CONDITION
X-A-1a(TS)	DRESS GRINDING WHEEL
X-A-1b(TS)	SET UP WORK PIECE AND MACHINE
X-A-1c(TS)	GRIND .500" DIAMETER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

X-A-1(TS)

TASK: CHECK MACHINE FOR PROPER RUNNING CONDITION

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINRDICAL GRINDER, PROPER ABRASIVE WHEEL, DIAMOND WHEEL DRESSER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LUBRICATE MACHINE	1. PLACE ONE OR TWO DROPS OF OIL IN EACH OIL CAP 2. FILL OIL RESERVOIR TO PROPER LEVEL 3. OIL WAYS LIGHTLY
2. CHECK COOLANT	CHECK LEVEL OF COOLANT IN TANK
3. CHECK GUARDS	ALL GUARDS IN PLACE NOTE: SPLASH GUARD MAY BE REMOVED UNTIL SETUP IS COMPLETE
4. TEST GRINDING WHEEL FOR SOUNDNESS	1. SELECT A SMALL BALL PEEN HAMMER 2. TAP WHEEL LIGHTLY ON SIDES IN SEVERAL PLACES 3. LISTEN FOR RING SOUND 4. IF DULL OR DEAD SOUND IS OBTAINED, REPLACE WHEEL

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, PP. 33-1 TO 33-15
REF. #2, PP. 565-581

TASK SHEET

X-A-1a(TS)

TASK: DRESS GRINDING WHEEL

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, ABRASIVE WHEEL AS DESIGNATED BY INSTRUCTOR, DIAMOND WHEEL DRESSER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT DIAMOND CUTTER	1. IN HOLDER
	2. CLAMP TO TABLE
	3. MOUNTED AT 10° TO 15° ANGLE TO WHEEL
	4. SLIGHTLY BELOW CENTER LINE OF WHEEL
2. ADJUST MACHINE	1. PUT ON GOGGLES
	2. BACK WHEEL AWAY FROM DIAMOND CUTTER
	3. START GRINDER WHEEL MOTOR, ALLOW SPINDLE BEARING TO WARM UP
	4. STOP GRINDER WHEEL MOTOR, ALLOW WHEEL TO STOP SPINNING
	5. ADJUST WHEEL UNTIL DIAMOND CUTTER IS IN CENTER OF WHEEL FACE
	6. ROTATE WHEEL BY HAND
	7. ADJUST WHEEL UNTIL DIAMOND CUTTER ALMOST TOUCHES THE HIGH POINT OF THE WHEEL
	8. TURN ON COOLANT
3. DRESS WHEEL FACE	1. TRAVERSE UNTIL DIAMOND IS AT EDGE OF WHEEL
	2. TURN ON GRINDER WHEEL MOTOR
	3. FEED WHEEL INTO DIAMOND CUTTER .001" PER PASS
	4. TRAVERSE BACK AND FORTH ACROSS WHEEL FACE AT A MEDIUM RATE OF SPEED

	5. REPEAT KEY POINTS 3 AND 4 UNTIL WHEEL FACE HAS BEEN COMPLETELY DRESSED
4. FINISH DRESS WHEEL FACE	1. USE AN INFEED OF .0005" 2. SLOWLY TRAVERSE FEED ACROSS FACE OF WHEEL 3. SLOWLY TRAVERSE ACROSS WHEEL FACE THREE ADDITIONAL PASSES WITH NO INFEED 4. STOP GRINDER WHEEL MOTOR
5. CLEAN WORK STATION	1. REMOVE DIAMOND CUTTER 2. CLEAN DIAMOND CUTTER AND HOLDER 3. RETURN TO STORAGE

TASK SHEET X-A-1b(TS)

TASK: SET UP WORK PIECE AND MACHINE

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, PROPER ABRASIVE WHEEL, DIAMOND WHEEL DRESSER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK PIECE	1. WIPE CLEAN THE FEMALE TAPER IN HEADSTOCK 2. WIPE WORK PIECE CLEAN 3. INSERT TAPER OF WORK PIECE INTO TAPER OF HEADSTOCK RAPIDLY TO SECURE IT TIGHTLY NOTE: SOME GRINDING HEADS HAVE TAPERS OTHER THAN #3 MORSE. IF NECESSARY USE AN ADAPTOR. CHECK WITH INSTRUCTOR
2. SET REVERSING DOGS	1. SET LEFT DOG TO REVERSE TABLE WHEN LEFT SIDE OF GRINDING WHEEL IS IN UNDERCUT ON WORK PIECE 2. SET RIGHT DOG TO REVERSE TABLE WHEN 1/2 THE GRINDING WHEEL FACE IS OFF WORK PIECE 3. RUN TABLE BACK AND FORTH SEVERAL TIMES TO CHECK REVERSING DOGS
3. SET TRAVEL SPEED	SET AT 12" PER MINUTE

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, P. 33-5
REF. #2, PP. 566-567

TASK SHEET

X-A-1c(TS)

TASK: GRIND .500" DIAMETER

JOB: SPOTFACER BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, PROPER ABRASIVE WHEEL, DIAMOND WHEEL DRESSER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FINAL ADJUSTMENTS	1. TURN HANDLE TO POSITION GRIND WHEEL 1/8" FROM WORK PIECE 2. START WORK ROTATION 3. START SPINDLE 4. START COOLANT PUMP NOTE: BE SURE PLENTY OF COOLANT IS FLOWING BETWEEN WORK PIECE AND WHEEL 5. ENGAGE TABLE TRAVEL 6. SLOWLY BRING WHEEL INTO WORK PIECE
2. MAKE LIGHT CUT	1. REMOVE ABOUT .002" OR ENOUGH STOCK TO CLEAN UP 2. DISENGAGE TABLE TRAVEL WHEN RIGHT END OF WORK PIECE IS ON WHEEL 3. TURN COOLANT PUMP OFF NOTE: WHEEL MAY BE LEFT TURNING IF CARE IS TAKEN NOT TO TOUCH IT
3. CHECK FOR TAPER	1. USE 1" MICROMETER AND CHECK DIAMETER AT BOTH ENDS OF GROUND SURFACE 2. ADJUST TAILSTOCK TO REMOVE TAPER IF NECESSARY
4. GRIND TO SIZE	CONTINUE GRINDING UNTIL .500" DIAMETER IS OBTAINED

5. DEBURR		USE A HONE OR FILE TO BREAK SHARP EDGES
6. CLEAN MACHINE	1.	TURN ALL MOTORS OFF
	2.	REMOVE WORK PIECE
	3.	REMOVE ALL TOOLS, CLEAN, AND RETURN TO PROPER PLACES
	4.	WIPE MACHINE CLEAN NOTE: AIR IS NOT TO BE USED ON GRINDER
7. INSPECT	1.	.500" DIAMETER
	2.	.938" DIAMETER 3/16" FROM SHOULDER
	3.	15/32" DIAMETER
	4.	23/32" DIAMETER
	5.	5/16" THICKNESS
	6.	1/4" RADII
	7.	9/32" RADII
	8.	FINISH

SKETCHES: DRAWING #2: SPOTFACER BAR

REFERENCES: REF. #1, P. 33-4
REF. #2, P. 566

MACHINE SHOP

GO AND NO-GO PLUG GAGES

ENGINE LATHE	2
MILLING MACHINE	3
CYLINDRICAL GRINDER	2
BENCH	1
HEAT TREAT	1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWING, AND CONSTRUCT A GO AND NO-GO GAGE ACCORDING TO SPECIFICATIONS; USING THE TOOLS, MATERIALS, EQUIPMENT, AND MACHINES CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR THE JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

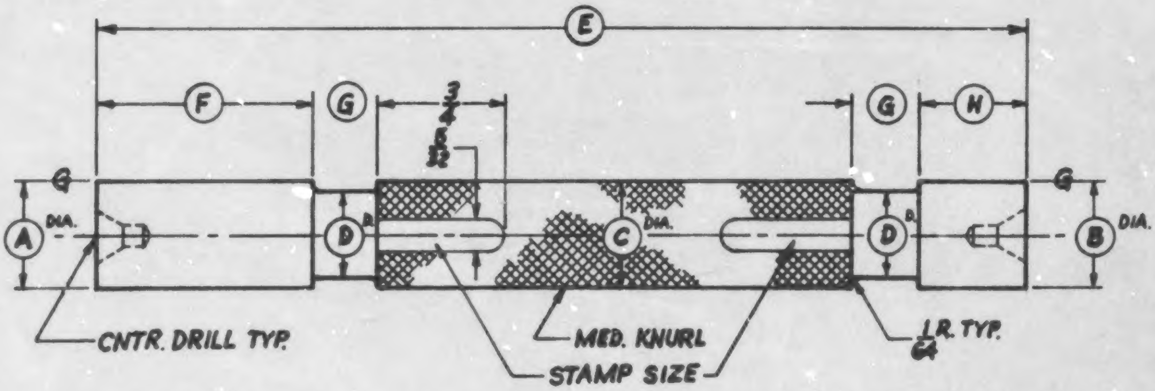
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A., AND WILLIAM J. McCARTHY, METAL TECHNOLOGY AND PRACTICE

REF. #3, WALKER JOHN., MACHINING FUNDAMENTALS

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR A 1" GO AND NO-GO GAGE AS SPECIFIED ON DRAWING #3. IF OTHER SIZES ARE DESIRED DIMENSIONS MUST BE CHANGED ACCORDINGLY AS PER DRAWING #3.


E
F
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3/4
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G
A DIA.
D DIA.
C DIA.
D DIA.
B DIA.
CNTR. DRILL TYP.
MED. KNURL
STAMP SIZE
1/64 R. TYP.

HARDEN-DRAW-GRIND

NOTE: GRIND TOLERANCE ±.0001

NOM. SIZE	"A" DIA.		"B" DIA.		C	D	E	F	G	H
	TURN	GRIND	TURN	GRIND						
1/4	.265	.250	.265	.2505	7/16	7/32	4	7/8	5/16	1/2
5/16	.325	.3125	.325	.313	7/16	9/32	4 3/16	15/16	5/16	1/2
3/8	.390	.375	.390	.3755	1/2	5/16	4 3/8	1	5/16	1/2
1/2	.520	.500	.520	.5005	9/16	7/16	4 15/16	1 1/8	3/8	9/16
5/8	.645	.625	.645	.6255	5/8	1/2	5 3/8	1 1/4	3/8	5/8
3/4	.770	.750	.770	.751	11/16	5/8	5 7/8	1 3/8	7/16	5/8
7/8	.895	.875	.895	.876	3/4	11/16	6 1/4	1 1/2	7/16	3/4
1	1.025	1.000	1.025	1.001	7/8	3/4	6 5/8	1 5/8	1/2	3/4

DRAWING NO. 3	"GO" & "NO GO" PLUG GAGES	TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 1 ENGINE LATHE JOB NO. 2 MILLING JOB NO. 3 HEAT TREAT JOB NO. 1 CYL. GRINDER JOB NO. 2	MATERIAL: TOOL STEEL FINISH: GRIND SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4 °

VII-C-1(J)

JOB SHEET IN ENGINE LATHE

JOB: GO AND NO-GO GAGE

MATERIAL: 1 1/8" X 6 3/4" TOOL STEEL

TOOLS AND EQUIPMENT:

ENGINE LATHE
UNIVERSAL CHUCK
TURNING TOOLS
MEDIUM KNURLING TOOL
0-1" MICROMETER
1-2" MICROMETER
FACE PLATE
TAILSTOCK CHUCK AND KEY
CENTER DRILL
HEAD CENTER
LIVE CENTER
LATHE DOG
12" RULE
10" MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHE, PP. 36-1, TO 36-44, REF. #2, LATHE, PP. 462-464. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

VII-A-1(TS)	CHECK MACHINE FOR PROPER RUNNING CONDITION.
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL.
VII-B-1d(TS)	SET UP AND TURN DIAMETER.
VII-C-1a(TS)	SET UP AND KNURL.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-C-1 (TS)

TASK:	SET UP, FACE, AND CENTER DRILL
JOB:	GO AND NO-GO GAGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, UNIVERSAL CHUCK, TURNING TOOLS, CENTER DRILL, TAILSTOCK CHUCK AND KEY, CLEAN RAGS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP CHUCK	1. CLEAN SPINDLE THREADS 2. MOUNT UNIVERSAL CHUCK ON SPINDLE 3. TIGHTEN CHUCK INTO POSITION
2. SET UP WORK PIECE	1. USE CHUCK KEY, OPEN CHUCK TO RECEIVE 1 1/8" DIAMETER TOOL STEEL 2. POSITION WORK PIECE IN CHUCK, LEAVE 1" PROTRUDING FROM CHUCK JAWS 3. TIGHTEN WORK PIECE IN CHUCK, USE CHUCK KEY 4. REMOVE CHUCK KEY
3. SET FEED AND SPEED	SEE CHART REF. #1, P. 36-15 OR REF. #2, P. 468
4. SET UP FACING TOOL	(REFER TO: VII-B-1b(TS))
5. FACE END OF WORK PIECE	1. PUT ON GOGGLES 2. FACE END TO CLEAN UP 3. (REFER TO: VII-B-1b(TS))
6. SET UP CENTER DRILL	1. MOUNT DRILL CHUCK IN TAILSTOCK SPINDLE 2. USE KEY OPEN DRILL CHUCK 3. INSERT CENTER DRILL INTO CHUCK 4. USE CHUCK KEY, TIGHTEN CHUCK FIRMLY ONTO CENTER DRILL

7. CENTER DRILL WORK PIECE	1. SLIDE TAIL STOCK TOWARD HEAD STOCK 2. POSITION CENTER DRILL 1" FROM WORK PIECE EXPOSED END 3. LOCK TAIL STOCK INTO POSITION 4. TURN ON LATHE 5. FEED CENTER DRILL INTO WORK PIECE WITH TAIL STOCK HAND WHEEL 6. CENTER DRILL TO PROPER DEPTH NOTE: SEE REF. #1, P. 36-17 OR REF. #2, P. 480
8. FACE AND CENTER DRILL OPPOSITE END OF WORK PIECE	1. REPEAT PROCEDURES PERFORMED ON FIRST END 2. HOLD LENGTH OF WORK PIECE TO 6 5/8"

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, PP. 36-14, 36-17, 36-23, AND 36-24
REF. #2, PP. 468, 479, AND 480

TASK SHEET

VII-C-1a (TS)

TASK: SET UP AND TURN DIAMETER

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, LATHE DOG, HAND TOOLS, TURNING TOOLS, DEAD CENTER, LIVE CENTER, CLEAN RAGS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL FACEPLATE	1. LAY BOARD ACROSS LATHE BED UNDER CHUCK TO PREVENT DAMAGE IN CASE CHUCK IS DROPPED 2. REMOVE UNIVERSAL CHUCK 3. INSTALL FACEPLATE 4. TIGHTEN FACEPLATE
2. INSTALL DEAD CENTER	1. WIPE FEMALE TAPER IN HEADSTOCK CLEAN 2. WIPE DEAD CENTER CLEAN 3. INSTALL DEAD CENTER IN HEADSTOCK
3. INSTALL LIVE CENTER	1. WIPE FEMALE TAPER IN TAILSTOCK CLEAN 2. WIPE LIVE LATHE CENTER CLEAN 3. INSTALL LIVE CENTER IN TAILSTOCK
4. SET UP TURNING TOOL	(REFER TO: VII-B-1d(TS) SPOTFACER BAR)
5. SET SPEED AND FEED	SEE CHART REF. #1, P. 36-14 OR REF. #2, P. 468
6. SET UP WORK	1. MOUNT LATHE DOG ON EITHER END OF WORK 2. TIGHTEN DOG

6.	SET UP WORK (CON'T.)	3.	PLACE WORK BETWEEN CENTERS NOTE: DOG TAIL MUST FIT INTO SLOT ON FACEPLATE WITH NO BINDING
		4.	USE LIGHT TENSION ON TAILSTOCK END
7.	TURN DIAMETER B	1.	PUT SAFETY GOGGLES ON
		2.	TURN DIAMETER B TO 1.025" ± .005" AS PER DRAWING AND 1" LENGTH NOTE: THE SHOULDER LEFT BY THIS CUT WILL BE LOCATED IN THE CENTER OF LENGTH G AND WILL BE TURNED DOWN LATER
8.	TURN DIAMETER A	1.	REVERSE DOG TO OPPOSITE END OF WORK
		2.	TURN DIAMETER A TO 1.025" ± .005" AS PER DRAWING AND 1 7/8" LENGTH
9.	LAYOUT	1.	LAYOUT LENGTH H, 3/4" FROM END
		2.	LAYOUT LENGTH F, 1 5/8" FROM END
10.	TURN DIAMETER C		TURN DIAMETER C TO 7/8" BETWEEN LAYOUT LINES NOTE: IT WILL BE NECESSARY TO USE BOTH RIGHT AND LEFT HAND TURNING TOOLS
11.	LAYOUT		LAYOUT LENGTH G, 1/2" FROM EACH SHOULDER AS PER DRAWING
12.	TURN BOTH DIAMETERS D		TURN DIAMETER D TO 3/4" BETWEEN SHOULDER AND LAYOUT LINE TO HOLD LENGTH G, 1/2"

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, PP. 36-14 TO 36-19
REF. #2, PP. 468, 481-483

TASK SHEET

TASK: SET UP AND KNURL

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, LATHE DOG, LIVE CENTER, DEAD CENTER, MEDIUM KNURLING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP KNURLING TOOL	1. REMOVE TOOL AND TOOL HOLDER FROM TOOL POST
	2. MOUNT KNURLING TOOL IN TOOL HOLDER
	3. TIGHTEN KNURLING TOOL IN TOOL POST
2. SET SPEED AND FEED	1. PLACE MACHINE IN BACKGEAR, SLOW RPM
	2. SET SLOW FEED
3. ADJUST KNURLING TOOL	1. TURN MACHINE ON
	2. MOVE CARRIAGE AND CROSS SLIDE UNTIL KNURLS TOUCH RIGHT END OF AREA TO BE KNURLED NOTE: BOTH WHEELS MUST BE TOUCHING WORK EVENLY AND WHEEL FACES PARALLEL TO WORK. IT MAY BE NECESSARY TO REALIGN KNURLING TOOL
4. KNURL	1. HAND FEED KNURLING TOOL INTO WORK
	2. OBSERVE DIAMOND PATTERN TAKING SHAPE
	3. ENGAGE AUTOMATIC FEED
	4. OIL AREA TO BE KNURLED
	5. WHEN KNURLING TOOL IS 1/2 ON AREA TO BE KNURLED AT OTHER END, REVERSE AUTOMATIC FEED

4. KNURL (CON'T.)	NOTE: DO NOT STOP MACHINE 6. TURN CROSS SLIDE HAND WHEEL CLOCKWISE TO APPLY MORE PRESSURE ON WORK FORCING KNURLS INTO WORK 7. REPEAT REVERSING AND ADDITIONAL PRESSURE AT EACH END OF KNURLED AREA UNTIL SATISFACTORY KNURL IS OBTAINED
5. DEBURR	1. BREAK ALL SHARP EDGES WITH A FILE 2. STOP MACHINE 3. REMOVE WORK
6. INSPECT	1. 1.025" DIAMETERS 2. 3/4" DIAMETERS 3. DIAMETER C WILL BE LARGER BECAUSE OF KNURLING 4. 1 5/8" LENGTH 5. 3/4" LENGTH 6. 1/2" LENGTH TWO PLACES 7. 3 1/4" LENGTH 8. 6 5/8" LENGTH
7. CLEAN WORK STATION	AS IN PRECEDING TASK

ROUTE TO VERTICAL MILL

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, PP. 36-36, 37
REF. #2, P. 486

IX-C-1(J)

JOB SHEET
IN
VERTICAL MILLING MACHINE

JOB: GO AND NO-GO GAGE

MATERIAL: MACHINED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:

VERTICAL MILLING MACHINE
3/4" END MILL WITH 1/8" RADIUS
MILLING MACHINE VISE
PARALLEL BARS
END MILL HOLDER
ALLEN WRENCH SET
LEAD HEAD HAMMER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, MILLING PP. 38-1 TO 38-38, REF. #2, MILLING, PP. 524-564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

IX-A-1(TS)	CHECK MACHINE FOR PROPER RUNNING CONDITION.
IX-C-1(TS)	SET UP MILL.
IX-C-1a(TS)	SET UP WORK PIECE AND MACHINE FLATS.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING TASK.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET IX-C-1(TS)

TASK: SET UP MILL

JOB: GO AND NO-GO GAGES

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, 3/4" END MILL WITH 1/8" RADIUS, PARALLEL BARS, END MILL HOLDER, ALLEN WRENCH SET, MILLING MACHINE VISE, LEAD HEAD HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP END MILL	1. SET UP END MILL HOLDER (SEE JOB #2, SPOTFACER BAR)
	2. INSERT END MILL INTO HOLDER
	3. TIGHTEN END MILL IN HOLDER
2. SET SPEED AND FEED	SEE CHART REF. #1, P. 38-16 OR REF. #2, PP. 549-550
3. SET UP VISE	1. CLEAN TABLE
	2. CLEAN BOTTOM OF VISE
	3. MOUNT VISE ON TABLE AND BOLT (SEE JOB #1, FLAT HEAD MACHINE SCREW)
4. INDICATE VISE TRUE	INDICATE VISE TRUE (SEE JOB #1, FLAT HEAD MACHINE SCREW)

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #2, PP. 549-550, 552-558

TASK SHEET

IX-C-1a(TS)

TASK: SET UP WORK PIECE AND MACHINE FLATS

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, 3/4" END MILL WITH 1/8" RADIUS, PARALLEL BARS, END MILL HOLDER, ALLEN WRENCH SET, MILLING MACHINE VISE, LEAD HEAD HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN VISE	1. OPEN VISE ABOUT 2" 2. WIPE INSIDE VISE CLEAN
2. SET UP WORK	1. WIPE PARALLEL BAR CLEAN 2. SET PARALLEL BAR IN VISE 3. LAY WORK PIECE ON PARALLEL 4. TIGHTEN VISE 5. TAP WORK LIGHTLY WITH LEAD HEAD HAMMER NOTE: THIS WILL ASSURE THAT WORK ON PARALLEL BAR ON BOTH ENDS
3. POSITION TOOL	1. PUT GOGGLES ON 2. TURN MACHINE ON 3. TURN NECESSARY HANDLES TO MOVE TABLE UNTIL END MILL IS POSITIONED 1/2" OVER WORK AND AT EITHER END OF KNURL
4. MACHINE FLATS	RAISE TABLE UNTIL CUTTER TOUCHES WORK

4. MACHINE FLATS (CON'T.)	2. MOVE TABLE UNTIL CUTTER IS OFF WORK
	3. RAISE TABLE .018" BY THE DIAL NOTE: THERE IS ONLY .018" TO BE REMOVED FOR FLAT. BE CAREFUL
	4. ENGAGE AUTOMATIC FEED
	5. CUT FLAT 3/4" LONG FROM END
	6. STOP MACHINE
	7. REPEAT SAME PROCEDURE ON OPPOSITE END OF KNURL
5. DEBURR	1. STOP MACHINE
	2. REMOVE WORK
	3. BREAK ALL SHARP EDGES WITH FILE
6. CLEAN UP MILL	1. REMOVE CHIPS WITH BRUSH
	2. WIPE MACHINE OFF
	3. RETURN ALL TOOLS TO PROPER PLACE
	4. DISPOSE OF WASTE

ROUTE TO BENCH

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, P. 38-33
REF. #2, PP. 556-559

IV-A-1(J)

JOB SHEET
IN
BENCH

JOB: GO AND NO-GO GAGE

MATERIALS: MACHINED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:
BENCH
ALUMINUM BLOCKS
BALL PEEN HAMMER
1/8" STAMPS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #2, STEEL STAMPING, PP. 431-432. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE PERFORMING ANY OPERATIONS.

PROCEDURE AND/OR TASKS:
IV-A-1(TS) STEEL STAMP WORK PIECE
IV-A-1a(TS) CLEAN WORK STATION. AS IN PRECEDING TASKS.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH THE TASK.

1. SELECTION OF TOOLS, AND TOOL CONDITION.
2. CHECK FOR PROPER SETUP.
3. ALL DIMENSION HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

IV-A-1(TS)

TASK:	STEEL STAMP WORK PIECE
JOB:	GO AND NO-GO GAGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	BENCH, BALL PEEN HAMMER, ALUMINUM BLOCKS, 1/8" NUMBER STEEL STAMPS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION WORK	1. PLACE ALUMINUM BLOCK ON BENCH 2. PLACE WORK PIECE ON ALUMINUM BLOCK 3. FLATS OF WORK PIECE UP
2. STAMP LONG END	1. STAMP LONG END FIRST NOTE: LONG END IS "GO" END NOTE: PRACTICE STAMPING 1.000" ON SCRAP PIECE 2. STAMP 1.000" ON LONG END OF WORK
3. STAMP SHORT END	1. REPEAT STAMPING PROCEDURE ON SHORT END 2. STAMP 1.001" ON SHORT END OF WORK
4. CLEAN UP	RETURN ALL TOOLS AND EQUIPMENT TO PROPER PLACE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCE: REF. #2, PP. 431-432

JOB SHEET
IN
HEAT TREAT

XI-A-1(J)

JOB: GO AND NO-GO GAGE

MATERIALS: MACHINED AND STAMPED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:

- HEAT TREAT FURNACE
- QUENCHING VAT WITH OIL
- TONGS
- LEATHER GLOVES
- FIRE EXTINGUISHER
- FACE SHIELD
- LEATHER APRON

PROCEDURE AND/OR TASKS:

XI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
XI-A-1a(TS)	LIGHT FURNACE.
XI-A-1b(TS)	HEAT TREAT WORK PIECE.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK EQUIPMENT FOR PROPER OPERATING CONDITION.
2. CHECK WORK PIECE FOR PROPER HEAT TREAT.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET XI-A-1(TS)

TASK: CHECK EQUIPMENT FOR PROPER OPERATING CONDITION

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: HEAT TREAT FURNACE, LEATHER APRON, LEATHER GLOVES, FACE SHIELD, TONGS, QUENCHING VAT, FIRE EXTINGUISHER, WORK PIECE, QUENCHING OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK SURROUNDING AREA	1. NO FLAMMABLE MATERIALS IN AREA 2. STUDENT SAFETY EQUIPMENT LAID OUT 3. FIRE EXTINGUISHER AVAILABLE
2. CHECK FIRE EXTINGUISHER	1. PROPER OPERATING CONDITION 2. FILLED WITH FIRE EXTINGUISHING MATERIAL 3. CLOSE AT HAND
3. CHECK FURNACE	1. EMPTY OF ANY MATERIAL 2. PROPER GAS FLOW 3. PROPER AIR FLOW 4. EXHAUST SYSTEM IN GOOD OPERATING CONDITION
4. CHECK QUENCHING VAT	1. VAT IN GOOD REPAIR 2. FILLED TO PROPER LEVEL WITH QUENCHING OIL

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, P. 31-4
REF. #2, PP. 357-369

TASK SHEET

XI-A-1a(TS)

TASK: LIGHT FURNACE

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: HEAT TREAT FURNACE, TONGS, LEATHER APRON, LEATHER GLOVES, FACE SHIELD, FIRE EXTINGUISHER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE TO LIGHT	1. PUT ON LEATHER APRON 2. PUT ON FACE SHIELD
2. LIGHT FURNACE	1. ROLL UP A 12" LONG PIECE OF PAPER 2. LIGHT ONE END OF PAPER WITH MATCH 3. PUT LIGHTED PAPER IN FURNACE 4. TURN AIR ON FIRST 5. TURN GAS ON MEDIUM

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, PP. 31-5 TO 31-6
REF. #2, P. 360

TASK SHEET XI-A-1b(TS)

TASK: HEAT TREAT WORK PIECE

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: HEAT TREAT FURNACE, LEATHER APRON, LEATHER GLOVES, FACE SHIELD, FIRE EXTINGUISHER, QUENCHING VAT, OIL, TONGS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. HEAT WORK PIECE	1. PICK UP WORK PIECE WITH TONGS
	2. GENTLY PLACE WORK PIECE IN FURNACE
	3. TO PREVENT WARPAGE PLACE WORK PIECE IN FURNACE ON END NOTE: BLOCK UP WORK PIECE SO IT WILL NOT FALL OVER
	4. CLOSE FURNACE DOOR
	5. HEAT WORK PIECE TO 1400° OR UNTIL IT IS A DEEP CHERRY RED
2. QUENCH WORK PIECE	1. GRASP WORK PIECE WITH TONGS
	2. HOLD WORK PIECE IN VERTICAL POSITION
	3. QUICKLY SUBMERGE WORK PIECE IN QUENCHING VAT OIL NOTE: WORK PIECE IS NOT TO BE SWIRLED OR DIPPED IN AND OUT OF OIL
	4. ALLOW WORK PIECE TO COOL IN OIL
3. LAP CENTER	1. MOUNT SHANK OF LAP IN DRILL PRESS CHUCK
	2. TIGHTEN CHUCK
	3. SET DRILL PRESS SPEED AT 400 TO 600 RPM
	4. HOLD WORK PIECE CENTERS ON LAP UNTIL CLEANED UP
4. CLEAN WORK STATION	1. TURN OFF FURNACE: AIR AND GAS

4. CLEAN WORK STATION (CON'T.)

2. LEAVE EXHAUST FAN RUNNING FOR 15 MINUTES BEFORE TURNING OFF
3. RETURN TOOLS TO STORAGE
4. CLEAN FLOW
5. CLEAN HEAT TREAT FURNACE

ROUTE TO CYLINDER GRINDER

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, PP. 31-5 TO 31-6
REF. #2, P. 360

X-B-1(J)

JOB SHEET
IN
CYLINDRICAL GRINDER

JOB: GO AND NO-GO GAGE

MATERIAL: MACHINED AND HARDENED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:

- CYLINDRICAL GRINDER
- PROPER ABRASIVE WHEEL, SEE INSTRUCTOR
- DIAMOND WHEEL DRESSER
- TWO CENTERS
- HONE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, GRINDING, PP. 33-1 TO 33-15, REF. #2, GRINDING, PP. 565-582. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

X-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
X-A-1a(TS)	DRESS WHEEL.
X-B-1(TS)	SET UP WORK PIECE AND GRINDING MACHINE.
X-B-1a(TS)	GRIND TWO DIAMETER.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SET UP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

X-B-1(TS)

TASK: SET UP WORK PIECE AND GRINDING MACHINE

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, PROPER ABRASIVE WHEEL, SEE INSTRUCTOR, TWO CENTERS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP CENTERS	1. WIPE HEADSTOCK CLEAN 2. INSERT CENTER 3. WIPE TAILSTOCK TAPER CLEAN 4. INSERT CENTER
2. MOUNT DOG	1. PUT GRINDING DOG ON LONG END OF WORK PIECE 2. TIGHTEN DOG
3. SET UP WORK PIECE	1. LUBRICATE POINT OF CENTER HELD IN TAILSTOCK NOTE: OIL AND WHITE LEAD MIXTURE IS GOOD 2. ADJUST TAILSTOCK INTO POSITION SAME AS LATHE ADJUSTMENT 3. MOUNT WORK PIECE a. BETWEEN CENTER b. SAME AS LATHE MOUNTING c. SAME TENSION AS LATHE MOUNTING 4. BE SURE DOG TAIL IS AGAINST TURNING PIN AND NOT BINDING
4. SET REVERSING DOGS	1. SET LEFT DOG TO REVERSE TABLE WHEN LEFT SIDE OF GRINDING WHEEL IS IN UNDER CUT ON WORK PIECE 2. SET RIGHT DOG TO REVERSE TABLE WHEN 1/2 THE GRINDING WHEEL FACE IS OFF WORK PIECE 3. OPERATE TABLE BACK AND FORTH SEVERAL TIMES TO CHECK REVERSING OF TABLE BY DOGS

5. SET TRAVEL SPEED 1. 12" PER MINUTE

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, P. 33-5
REF. #2, PP. 566-567

TASK SHEET X-B-1a (TS)

TASK: GRIND TWO DIAMETERS

JOB: GO AND NO-GO GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, TWO CENTERS, PROPER ABRASIVE WHEEL, SEE INSTRUCTOR, HONE, OIL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GRIND SHORT END	1. PUT SAFETY GOGGLES ON
	2. GRIND SHORT END OF WORK PIECE TO HOLD 1.001" ± .0001"
	3. GRIND IN SAME MANNER AS #2, SPOTFACER BAR
2. GRIND LONG END	1. REMOVE WORK FROM MACHINE
	2. REMOVE DOG FROM WORK
	3. MOUNT DOG ON OPPOSITE END NOTE: USE SHIM STOCK BETWEEN DOG SCREW AND WORK TO PREVENT SCARRING
	4. GRIND LONG END TO HOLD 1.000" ± .0001"
3. DEBURR	USE HONE TO BREAK SHARP EDGES NOTE: DO NOT USE A FILE. WORK PIECE IS TOOL HARD
4. CLEAN MACHINE	(REFER TO: X-A-1c(TS) SPOTFACER BAR)
5. INSPECT	1. 1.001" DIAMETER
	2. 1.000" DIAMETER
	3. 3/4" DIAMETER TWO PLACES
	4. 7/8" DIAMETER
	5. 1 5/8" LENGTH
	6. 1/2" LENGTH TWO PLACES
	7. 3 1/4" LENGTH
	8. 3/4" LENGTH
	9 6 5/8" LENGTH
	10. 3/4" X 1/4" FLAT

SKETCHES: DRAWING #3: GO AND NO-GO GAGE

REFERENCES: REF. #1, P. 33-4
REF. #2, P. 566

MACHINE SHOP PLUG GAGE HANDLE

ENGINE LATHE 3

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A PLUG GAGE ACCORDING TO SPECIFICATIONS; USING THE TOOLS, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB

CHECKING STANDARDS

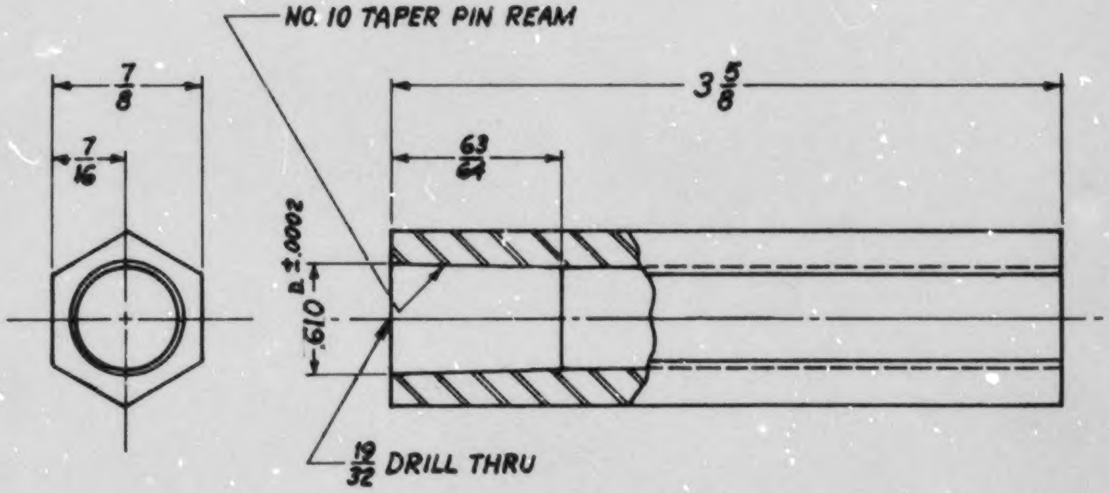
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR THE JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A., AND WILLIAM J. McCARTHY, METAL TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS


NO. 10 TAPER PIN REAM
7/8
7/16
3 5/8
63/64
B ±.0002
.610
19/32 DRILL THRU

DRAWING NO. 4	PLUG GAGE HANDLE	TOLERANCES UNLESS OTHERWISE NOTED
ENGINE LATHE JOB NO. 3	MATERIAL: AL. ALLOY FINISH: TOOL SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-D-1(J)

JOB SHEET
IN
ENGINE LATHE

JOB: PLUG GAGE HANDLE

MATERIAL: 7/8" X 3 3/4" HEXAGON ALUMINUM

TOOLS AND EQUIPMENT:

ENGINE LATHE
UNIVERSAL CHUCK
TAILSTOCK CHUCK AND KEY
CENTER DRILL
FACING TOOL
10" MILL FILE
19/32" DRILL
#10 TAPERED REAMER
#A TELESCOPE GAGE
0-1" MICROMETER
6" RULE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHE, PP. 36-1 TO 36-44, REF. #2, LATHE, PP. 462-494. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
VII-B-1b(TS)	SET UP AND FACE ONE END TO CLEAN UP WORK PIECE.
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL OPPOSITE END.
VII-D-1(TS)	SET UP AND DRILL 19/32" THROUGH HOLE.
VII-D-1a(TS)	SET UP AND REAM TAPER.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER RUNNING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSION HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK:	SET UP AND DRILL 19/32" HOLE THROUGH
JOB:	PLUG GAGE HANDLE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, CENTER DRILL, FACING TOOL, UNIVERSAL CHUCK, TAILSTOCK CHUCK AND KEY, 19/32" DRILL, #A TELESCOPING GAGE, 0-1" MICROMETER, 6" RULE, 10" MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP DRILL	1. MOUNT DRILL CHUCK IN TAILSTOCK 2. MOUNT 19/32" DRILL IN CHUCK 3. TIGHTEN CHUCK ON DRILL
2. POSITION TAILSTOCK	1. POSITION TAILSTOCK UNTIL POINT OF DRILL IS 1/2" FROM WORK PIECE 2. LOCK TAILSTOCK
3. SET RPM	SEE CHART REF. #1, P. 36-14 OR REF. #2, P. 468
4. DRILL	1. ADVANCE DRILL INTO WORK PIECE USING THE TAILSTOCK HANDWHEEL 2. DRILL HOLE THROUGH NOTE: IT WILL BE NECESSARY TO BACK DRILL OUT ABOUT EVERY 1/4" DRILLED TO CLEAR CHIPS FROM FLUTE 3. LEAVE MACHINE SET UP

SKETCHES: DRAWING #4: PLUG GAGE HANDLE

REFERENCES: REF. #1, PP. 36-17 AND 36-35
REF. #2, PP. 479-480 AND 485

TASK:	SET UP AND REAM TAPER
JOB:	PLUG GAGE HANDLE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, UNIVERSAL CHUCK, TAILSTOCK CHUCK AND KEY, #10 TAPERED REAMER, #A TELESCOPING GAGE, 0-1" MICROMETER, 6" RULE, 10" MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP REAMER	1. MOVE TAILSTOCK BACK 2. REMOVE DRILL 3. INSERT DRILL CHUCK IN TAILSTOCK 4. INSERT #10 PIN REAMER IN CHUCK 5. TIGHTEN CHUCK WITH KEY NOTE: A #10 PIN REAMER HAS A 5/8" SHANK. HOLE MAY BE REAMED BY USE OF TAP WRENCH IF CHUCK WILL NOT OPEN LARGE ENOUGH 6. POSITION TAILSTOCK FOR REAMING. SAME AS FOR DRILLING 7. LOCK TAILSTOCK
2. SET SPEED	RPM SHOULD BE SLOW. SEE CHART REF. #1, 36-14 OR REF. #2, 468
3. REAM	1. ADVANCE REAMER SLOWLY INTO WORK USING TAILSTOCK HANDWHEEL NOTE: USE OIL 2. HOLD .610" ± .0002" NOTE: CHECK FREQUENTLY WITH TELESCOPE GAGE AND MICROMETER CAUTION: THERE IS ONLY A SMALL AMOUNT OF MATERIAL TO BE REMOVED, ALUMINUM IS SOFT, AND HOLE CAN EASILY BECOME TOO LARGE
4. DEBURR	1. BREAK ALL SHARP EDGES 2. TURN MACHINE OFF 3. REMOVE WORK PIECE

5. INSPECT	1. 19/32" DIAMETER 2. .610" DIAMETER 3. 63/64" LENGTH 4. 3 5/8" LENGTH
6. CLEAN MACHINE	1. REMOVE CHIPS WITH BRUSH 2. WIPE MACHINE OFF 3. RETURN ALL TOOLS TO THEIR PROPER PLACE 4. DISPOSE OF WASTE

SKETCHES: DRAWING #4: PLUG GAGE HOLDER

REFERENCES: REF. #1, P. 36-36
REF. #2, P. 485

MACHINE SHOP

TAPER PLUG GAGE

ENGINE LATHE	4
HEAT TREAT	2
CYLINDER GRINDER	3

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A TAPER PLUG GAGE ACCORDING TO SPECIFICATIONS; USING THE MACHINE AND PROCEDURES CALLED FOR IN THE JOB.

CHECKING STANDARDS

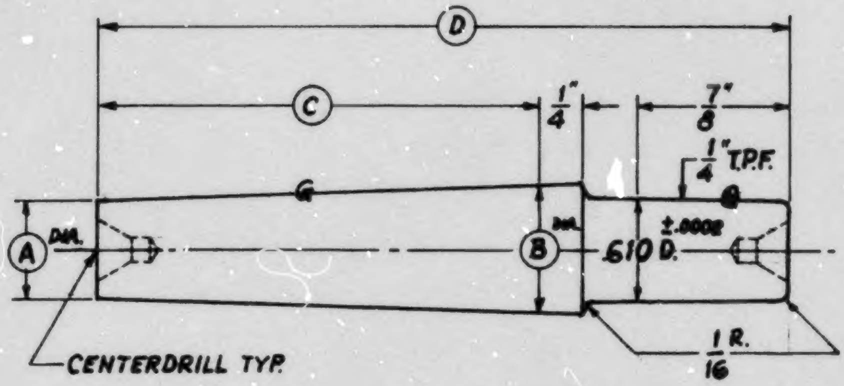
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR THE JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
8. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A., AND WILLIAM J. McCARTHY, METAL TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS


D
C
1"/4
7"/8
1"/4 T.P.F.
G
G
A DIA.
B DIA.
.610 D.
±.0002
1/16 R.
CENTERDRILL TYP.

HARDEN & GRIND
ALLOW .012 TO .015 FOR GRINDING
GRINDING TOLERANCE : ±.0002

MORSE TAPER	A	B	C	D	T.P.F.
#2	.572	.700	2 9/16	4	.599
#3	.778	.938	3 5/16	4 3/4	.602
#4	1.020	1.231	4 1/16	5 9/16	.623

DRAWING NO. 5	TAPER PLUG GAGE	TOLERANCES UNLESS OTHERWISE NOTED
ENGINE LATHE JOB NO. 4 CYL. GRINDER JOB NO. 3 HEAT TREAT JOB NO. 2	MATERIAL: TOOL STEEL FINISH: GRIND SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4 °

VII-E-1(J)

JOB SHEET
IN
ENGINE LATHE

JOB: TAPER PLUG GAGE

MATERIAL: 1" X 5" TOOL STEEL

TOOLS AND EQUIPMENT:

- ENGINE LATHE
- UNIVERSAL CHUCK
- FACE PLATE
- FACING TOOLS
- TAILSTOCK CHUCK AND KEY
- CENTER DRILL
- DEAD CENTER
- LIVE CENTER
- LATHE DOG
- 6" RULE
- 0-1" MICROMETER
- 1-2" MICROMETER
- DIAL INDICATOR
- 10" MILL FILE
- TURNING TOOLS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, PP. 36-1 TO 36-34, REF. #2, LATHES, PP. 462-494. STUDY JOB AND TASK SHEETS. CONFER WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL BOTH ENDS OF PIECE. HOLD WORK PIECE LENGTH TO 4 3/4".
VII-E-1(TS)	SET UP AND TURN #3 MORSE TAPER.
VII-E-1a(TS)	SET UP AND TURN 1/4" TAPER PER FOOT ON WORK PIECE SHORT END.
VII-E-1b(TS)	FILE 1/16" RADIUS ON SHORT TAPER END.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-E-1 (TS)

TASK: SET UP AND TURN #3 MORSE TAPER

JOB: TAPER PLUG GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, LATHE DOG, LIVE CENTER, DEAD CENTER, TURNING TOOLS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP FACE PLATE	1. MOUNT FACE PLATE 2. TIGHTEN FACE PLATE
2. SET UP WORK	1. MOUNT DOG ON EITHER END 2. SET UP WORK BETWEEN CENTERS (REFER TO: VII-B-1g(TS) GO AND NO-GO GAGE)
3. TURN TAPER	1. SET UP TAPER ATTACHMENT OR COMPOUND REST (REFER TO: VII-B-1g(TS) SPOTFACER BAR) 2. PUT SAFETY GOGGLES ON 3. TURN #3 MORSE TAPER NOTE: HOLD .958" DIAMETER, 3 5/16" FROM END AND .798" DIAMETER AT END. THIS ALLOWS .020" FOR GRINDING

SKETCHES: DRAWING #5: TAPER PLUG GAGE

REFERENCES: REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 173-178

TASK SHEET VII-E-1a (TS)

TASK: SET UP AND TURN 1/4" TAPER PER FOOT ON SHORT END

JOB: TAPER PLUG GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, LATHE DOG, LIVE CENTER, DEAD CENTER, TURNING TOOLS, DIAL INDICATOR, WORK

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK	1. PLACE LATHE DOG ON TAPERED END 2. TIGHTEN DOG 3. PLACE WORK BETWEEN CENTERS AS BEFORE
2. SET UP TAPER	1. SET TAPER ATTACHMENT OR COMPOUND REST ON 1/2° NOTE: EXACT ANGLE IS 36' AND CAN ONLY BE ESTIMATED 2. SET UP DIAL INDICATOR (REFER TO: VII-B-1h(TS) SPORTFACER BAR) 3. INDICATE .025" TAPER IN 1 3/16" LENGTH
3. SET UP TURNING TOOL	USE TOOL WITH 1/16" RADII
4. TURN TAPER	1. PUT SAFETY GOGGLES ON 2. TURN TAPER SAME AS BEFORE NOTE: HOLD .605" DIAMETER ON END AND .630" DIAMETER, 7/8" FROM END. THIS ALLOWS .020" FOR GRINDING

SKETCHES: DRAWING #5: TAPER PLUG GAGE

REFERENCES:
REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 172-178

TASK: FILE 1/16" RADII ON END

JOB: TAPER PLUG GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, LATHE DOG, LIVE CENTER, DEAD CENTER, 10" MILL FILE, 0-1" MICROMETER, 1-2" MICROMETER, 6" RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FILE RADII	NOTE: THIS TYPE RADII COULD BE TURNED BY USING A 1/16" RADII TURNING TOOL. HOWEVER TO TEACH SPEED THE FOLLOWING METHOD WILL BE USED AS THIS TYPE RADII IS NOT IMPORTANT. THE PURPOSE OF THIS TYPE RADII IS TO PERMIT EASY START AND NO BINDING IN PLUG GAGE HANDLE
	1. LAY SIDE OF FILE ON END OF WORK PIECE WHILE WORK IS ROTATING
	2. FILE 1/16" RADII NOTE: KEEP FILE CLEAN WITH FILE CARD
2. DEBURR	BREAK ALL SHARP EDGES WITH FILE
3. INSPECT	1. .798" DIAMETER
	2. .958" DIAMETER, 3 5/16" FROM END
	3. .605" DIAMETER
	4. .630" DIAMETER, 7/8" FROM END
	5. 1 3/16" CALCULATED LENGTH
	6. 3 9/16" CALCULATED LENGTH
	7. 4 3/4" LENGTH
4. CLEAN MACHINE	1. REMOVE CHIPS WITH BRUSH
	2. WIPE MACHINE OFF
	3. RETURN ALL TOOLS TO THEIR PROPER PLACE
	4. DISPOSE OF WASTE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #5: TAPER PLUG GAGE

XI-B-1(J)

JOB SHEET
IN
HEAT TREAT

JOB:	TAPER PLUG GAGE
MATERIAL:	MACHINE TOOL STEEL WORK PIECE
TOOLS AND EQUIPMENT:	QUENCHING OIL FURNACE LAP QUENCHING VAT TONGS DRILL PRESS
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, HEAT TREAT, PP. 31-1 TO 31-8, REF. #2, HEAT TREAT, PP. 357-369. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING FURNACE.
PROCEDURE AND/OR TASKS:	XI-A-1(TS) CHECK FURNACE FOR PROPER OPERATING CONDITION XI-A-1a(TS) LIGHT FURNACE XI-A-1b(TS) HEAT TREAT WORK PIECE XI-A-1c(TS) LAP CENTERS ROUTE TO CYLINDRICAL GRINDER

X-C-1(J)

JOB SHEET
IN
CYLINDER GRINDER

JOB: TAPER PLUG GAGE

MATERIAL: HEAT TREATED MACHINED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:

CYLINDRICAL GRINDER	ABRASIVE WHEEL
TWO CENTERS	DIAMOND DRESSER
GRINDING DOG	HONE
0-1" MICROMETER	
6" RULE	

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, GRINDING, PP. 33-1 TO 33-15, REF. #2, GRINDING, PP. 565-581. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

X-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
X-C-1(TS)	SET UP MACHINE AND WORK PIECE.
X-C-1a(TS)	GRIND #3 MORSE TAPER.
X-C-1b(TS)	GRIND 1/4" TAPER PER FOOT.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

X-C-1(TS)

TASK:	SET UP MACHINE AND WORK PIECE
JOB:	TAPER PLUG GAGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	CYLINDRICAL GRINDER, TWO CENTERS, ABRASIVE WHEEL, DIAMOND DRESSER, GRINDING DOG, HONE, 0-1" MICROMETER, 1-2" MICROMETER, 6" RULE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK	1. MOUNT DOG ON SHORT END OF WORK 2. MOUNT WORK BETWEEN CENTERS SAME AS JOB #3, GO AND NO-GO GAGE
2. DRESS WHEEL	1. PUT SAFETY GOGGLES ON 2. DRESS WHEEL (REFER TO: X-A-1a(TS) SPOTFACER BAR)
3. SET DOGS	SET REVERSING DOGS (REFER TO: X-A-1b(TS) SPOTFACER BAR)
4. SET UP TAPER	1. ADJUST TAILSTOCK TO GRIND #3 MORSE TAPER NOTE: TO SET A TAPER ON A CYLINDRICAL GRINDER THE TABLE OR HEADSTOCK MAY BE SWIVELED, AND MAY BE GRADUATED IN EITHER DEGREES OR TAPER PER FOOT. THE FOLLOWING SEQUENCE IS TO OFF-SET THE TABLE 2. REMOVE PIN NOTE: TABLE PIN HOLDS TABLE IN EXACT PARALLEL POSITION TO WAYS 3. LOOSEN TABLE LOCKING BOLTS 4. MOVE TAILSTOCK IN TO .603" TAPER PER FOOT OR .050" TAPER PER INCH 5. TIGHTEN TABLE LOCKING BOLTS

SKETCHES: DRAWING #5: TAPER PLUG GAGE

REFERENCES: REF. #1, P. 33-1
REF. #2, P. 567
REF. #3, PP. 304-305

TASK SHEET X-C-1a(TS)

TASK:	GRIND #3 MORSE TAPER
JOB:	TAPER PLUG GAGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	CYLINDRICAL GRINDER, TWO CENTERS, ABRASIVE WHEEL, DIAMOND DRESSER, GRINDING DOG, HONE, 0-1" MICROMETER, 1-2" MICROMETER, 6" RULE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GRIND TAPER	1. GRIND TAPER IN SAME MANNER AS STRAIGHT GRINDING NOTE: AFTER WORK HAS BEEN GROUND TO CLEAN UP, STOP MACHINE AND CHECK TAPER. IF NECESSARY READJUST TABLE SLIGHTLY UNTIL EXACT TAPER IS OBTAINED
	2. HOLD .938" ± .0002" DIAMETER, 3 5/16" FROM END AND .778" ± .0002" DIAMETER ON END

SKETCHES: DRAWING #5: TAPER PLUG GAGE

REFERENCES: REF. #1, P. 33-5
REF. #2, P. 567
REF. #3, PP. 304-304

TASK SHEET

TASK: GRIND 1/4" TAPER PER FOOT

JOB: TAPER PLUG GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, TWO CENTERS, ABRASIVE WHEEL, DIAMOND DRESSER, GRINDING DOG, HONE, 0-1" MICROMETER, 6" RULE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP MACHINE	1. MOUNT DOG ON GROUND END NOTE: PROTECT WORK WITH SHIM STOCK UNDER DOG SCREW 2. MOUNT WORK BETWEEN CENTERS 3. READJUST TAPER ON TABLE TO 1/4" TAPER PER FOOT 4. TIGHTEN TABLE LOCKING BOLTS 5. READJUST REVERSING DOGS NOTE: REVERSING DOG ON LEFT SHOULD BE SET TO REVERSE TABLE WHEN LEFT SIDE OF GRINDING WHEEL IS 1/16" FROM SHOULDER
2. DRESS WHEEL	1. IF NECESSARY DRESS FACE OF WHEEL WITH DIAMOND AS BEFORE 2. DRESS 1/16" RADII ON LEFT EDGE OF GRINDING WHEEL NOTE: USE A RADII WHEEL DRESSER AND DIAMOND. A CARBORUNDUM STICK MAY BE USED TO DRESS WHEEL BY HAND
3. GRIND TAPER	GRIND TAPER IN SAME MANNER AS BEFORE. HOLD .585" ± .0002" DIAMETER ON END AND .610" ± .0002" DIAMETER, 7/8" FROM END
4. GRIND SHOULDER	1. STOP AUTOMATIC FEED WHEN WHEEL

4. GRIND SHOULDER (CON'T.)	IS NEAR SHOULDER 2. HAND FEED WORK PIECE SHOULDER VERY SLOWLY INTO SIDE OF GRINDING WHEEL, BY TURNING TABLE LONGITUDINAL HANDWHEEL. HOLD 1 3/16" CALCULATED LENGTH
5. DEBURR	USE HONE TO BREAK SHARP EDGES NOTE: WORK TOO HARD FOR FILE
6. INSPECT	1. .778" DIAMETER 2. .938" DIAMETER 3 5/16" FROM END 3. .585" DIAMETER 4. .610" DIAMETER 7/8" FROM END 5. 4 3/4" LENGTH 6. 1/16" RADII TWO PLACES 7. FINISH
7. CLEAN MACHINE	SEE JOB #2, SPOTFACER BAR

SKETCHES: DRAWING #5: TAPER PLUG GAGE

REFERENCES: REF. #1, P. 33-5
REF. #2, P. 567
REF. #3, PP. 304-305

MACHINE SHOP LATHE CENTER

ENGINE LATHE	5
HEAT TREAT	3
CYLINDRICAL GRINDER	4
AIM	THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS AND CONSTRUCT A LATHE CENTER ACCORDING TO SPECIFICATIONS; USING MACHINES, PROCESSES, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR THE JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD SURFACE TO STANDARDS OF CRAFTSMANSHIP.
6. HOLD ALL SURFACES TO PRECISION FINISH.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

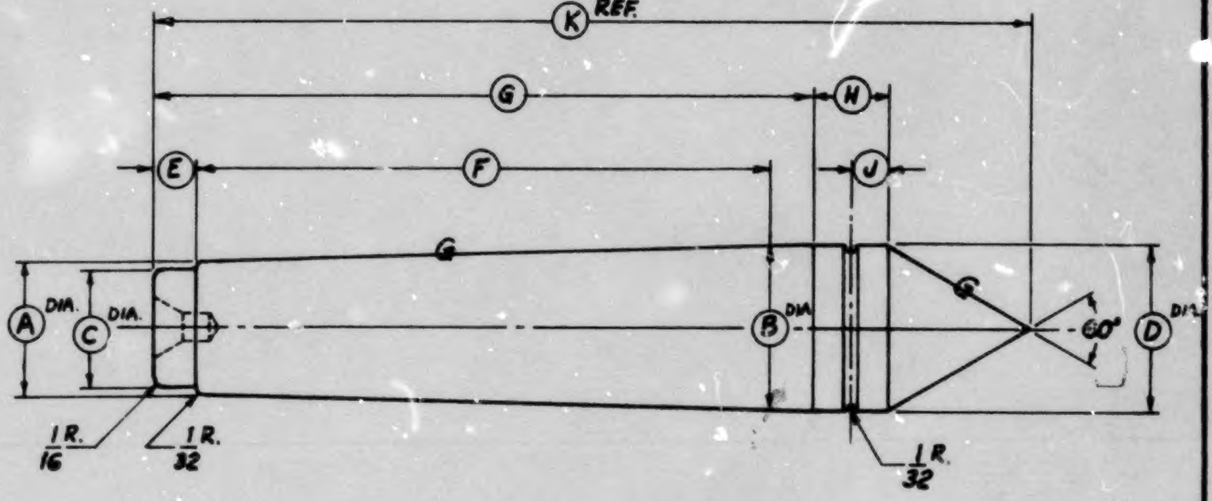
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A., AND WILLIAM J. McCARTHY, METAL TECHNOLOGY AND PRACTICE

REF. #3, WALKER JOHN R., MACHINING FUNDAMENTALS

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR #3 MORSE TAPER ON DRAWING #6. IF ANY OTHER TAPERS ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.


K REF.
G
H
E
F
J
G
A DIA.
C DIA.
B DIA
G
60°
D DIA
1/16 R.
1/32 R.
1/32 R.

HARDEN & GRIND

ALLOW .020 FOR GRINDING
GRINDING TOLERANCES: ±.0002

CENTER NUMBER	T.P.F.	A	B	C	D	E	F	G	H	J	K
2	.599	.572	.700	1/2	.715	3/16	2 9/16	3	5/16	5/32	4 5/32
3	.602	.778	.938	11/16	.958	1/4	3 5/16	3 13/16	7/16	7/32	5 3/32
4	.623	1.020	1.231	15/16	1.248	3/8	4 1/16	4 11/16	9/16	9/32	6 3/32

DRAWING NO. 6	LATHE CENTERS	TOLERANCES UNLESS OTHERWISE NOTED
ENGINE LATHE JOB NO. 5 CYL. GRINDER JOB NO. 4 HEAT TREAT JOB NO. 3	MATERIAL: TOOL STEEL FINISH: GRIND SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4 °

VII-F-1(J)

JOB SHEET
IN
ENGINE LATHE

JOB: LATHE CUTTER

MATERIAL: 1" X 5 3/4" TOOL STEEL

TOOLS AND EQUIPMENT:

ENGINE LATHE
UNIVERSAL CHUCK
FACE PLATE
TAILSTOCK CHUCK AND KEY
1/16" GROOVE CUTTING TOOL
FACING TOOL
TURNING TOOLS
DEAD CENTER
LATHE DOG
0-1" MICROMETER
6" RULE
DIAL INDICATOR
CENTER DRILL
10" MILL FILE
LIVE CENTER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHE, PP. 36-1 TO 36-44, REF. #2, LATHE, PP. 462-494. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL BOTH ENDS. FACE TO CLEAN UP AS LENGTH IS NOT IMPORTANT.
VII-B-1d(TS)	SET UP AND TURN STRAIGHT DIAMETER .970". THIS IS TO LEAVE .012" GRINDING STOCK.
VII-B-1d(TS)	SET UP AND TURN "C" DIAMETER, HOLD 11/16" X 1/4".
VII-F-1(TS)	SET UP AND TURN #3 MORSE TAPER.
VII-B-1f(TS)	SET UP AND TURN 1/16" RADIUS.
VII-F-1a(TS)	SET UP AND TURN 60° ANGLE.
VII-F-1b(TS)	SET UP AND CUT GROOVE.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-F-1 (TS)

TASK:	SET UP AND TURN #3 MORSE TAPER
JOB:	LATHE CENTER
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, UNIVERSAL CHUCK, FACE PLATE, TAILSTOCK CHUCK AND KEY, TURNING TOOLS, DEAD CENTER, LIVE CENTER, LATHE DOG, 10" MILL FILE, WORK PIECE, 0-1" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP	1. SET UP FACE PLATE 2. SET UP WORK BETWEEN CENTERS (REFER TO: VII-B-1g(TS) GO AND NO-GO GAGE)
2. SET UP TAPER	1. PUT SAFETY GOGGLES ON 2. SET UP TAPER ATTACHMENT (REFER TO: VII-F-1 SPOTFACER BAR)
3. TURN TAPER	TURN #3 MORSE TAPER NOTE: HOLD .958" DIAMETER 3 5/16" FROM SHOULDER AND .798" DIAMETER AT THE SHOULDER. THIS ALLOWS .020" FOR GRINDING
4. TURN 1/32" RADII	TURN RADII (REFER TO: VII-B-1f(TS) PLUG GAGE HANDLE)

SKETCHES: DRAWING #6: LATHE CENTER

REFERENCES: REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 172-178

TASK SHEET

VII-F-1a(TS)

TASK: SET UP AND TURN 60° ANGLE

JOB: LATHE CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TURNING TOOL, 0-1" MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK	INSERT #3 MORSE TAPER END INTO SPINDLE (REFER TO: VII-B-1g(TS) SPOT-FACER BAR)
2. SET UP COMPOUND REST	1. SET COMPOUND REST ON 30° or 60° INCLUDED ANGLE NOTE: COMPOUND REST HANDWHEEL SHOULD BE POINTING TOWARD HEADSTOCK 2. TIGHTEN LOCKING NUTS
3. SET UP TOOL	1. SET UP RIGHT HAND TURNING TOOL (REFER TO: VII-B-1c(TS) SPOTFACER BAR) NOTE: BE SURE TOOL POST IS TO EXTREME LEFT SIDE OF COMPOUND REST 2. TIGHTEN TOOL POST
4. POSITION TOOL	1. MOVE CARRIAGE UNTIL TOOL IS NEAR WORK 2. LOCK CARRIAGE
5. TURN 60° ANGLE	TURN 60° ANGLE USING COMPOUND REST NOTE: TURN END TO A POINT, THEN CONTINUE TURNING UNTIL LENGTH H ON DRAWING IS 15/32" LONG. THIS ALLOWS GRINDING STOCK ON ANGLE AND LENGTH H, 7/16" WILL BE HELD LATER

SKETCHES: DRAWING #6: LATHE CENTER

REFERENCES:
REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 172-178

TASK SHEET

TASK:	SET UP AND CUT GROOVE
JOB:	LATHE CENTER
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, 1/16" GROOVE CUTTING TOOL, 6" RULE VERNIER CALIPER, DIAL INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TOOL	1. LEAVE WORK SET UP 2. REMOVE TURNING TOOL 3. SET UP 1/16" WIDE GROOVE CUTTING TOOL __NOTE:__ BE SURE THERE IS 1/32" RADII ON BOTH EDGES OF TOOL
2. SET COMPOUND REST	1. TURN COMPOUND REST TO STANDARD POSITION 29° 2. LOCK COMPOUND REST
3. POSITION TOOL	1. LOOSEN TOOL POST 2. SET CUTTING TOOL PERPENDICULAR TO WORK 3. TIGHTEN TOOL POST
4. POSITION CARRIAGE	1. MOVE CARRIAGE TOWARD HEADSTOCK AND CROSS SLIDE IN UNTIL END OF TOOL IS NEAR WORK 2. MOVE CARRIAGE UNTIL RIGHT SIDE OF GROOVE CUTTING TOOL IS 3/16" FROM 60° ANGLE __NOTE:__ THIS IS LENGTH J ON DRAWING PLUS EXCESS STOCK, WHEN 60° ANGLE IS GROUND, LENGTH J (7/32") WILL BE HELD 3. LOCK CARRIAGE
5. TURN GROOVE	1. TURN MACHINE ON 2. HAND FEED CROSS SLIDE IN UNTIL TOOL TOUCHES WORK

5. TURN GROOVE (CON'T.)	3.	TURN CROSS SLIDE IN SLOWLY .060" ACCORDING TO THE DIAL
6. DEBURR		AS IN PRECEDING TASKS
7. INSPECT	1.	.798" DIAMETER
	2.	.958" DIAMETER
	3.	11/16" DIAMETER
	4.	.970" DIAMETER
	5.	1/4" LENGTH E
8. CLEAN MACHINE	1.	REMOVE CHIPS WITH BRUSH
	2.	WIPE MACHINE OFF
	3.	RETURN ALL TOOLS TO THEIR PROPER PLACE
	4.	DISPOSE OF WASTE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #6: LATHE CENTER

REFERENCES: REF. #1, P. 36-24
REF. #2, P. 487

JOB SHEET
IN
HEAT TREAT

XI-C-1(J)

JOB:	LATHE CENTER
MATERIAL:	MACHINED TOOL STEEL WORK PIECE
TOOLS AND EQUIPMENT:	FURNACE QUENCHING VAT WITH OIL TONGS
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, HEAT TREAT, PP. 31-1 TO 31-8, REF. #2, HEAT TREAT, PP. 357-369. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING FURNACE

PROCEDURE AND/OR TASKS:	XI-A-1(TS)	CHECK FURNACE FOR PROPER OPERATING CONDITION.
	XI-C-1a(TS)	HEAT TREAT WORK PIECE

ROUTE TO CYLINDER GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

XI-C-1a (TS)

TASK: HEAT TREAT
JOB: LATHE CENTER
TRADE: MACHINIST
TOOLS AND MATERIALS: DRILL PRESS, LAP
TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN UP	NOTE: FOLLOWING THE COMPLETION OF HEAT TREAT TASKS DO: 1 1. TURN GAS OFF 2. TURN AIR OFF 3. LEAVE EXHAUST FAN ON FIFTEEN MINUTES THEN TURN OFF 4. RETURN TOOLS AND EQUIPMENT TO PROPER PLACE
2. LAP CENTERS	(REFER TO: XI-A-1c(TS) TAPER PLUG GAGE)

ROUTE TO CYLINDRICAL GRINDER

SKETCHES: DRAWING #6: LATHE CENTER

REFERENCES: REF. #1, PP. 31-5 TO 31-6
REF. #2, P. 360

JOB SHEET
IN
CYLINDER GRINDER

X-D-1(J)

JOB: LATHE CENTER

MATERIAL: MACHINED AND HEAT TREATED TOOL STEEL WORK PIECE

TOOLS AND EQUIPMENT:

CYLINDRICAL GRINDER	GRINDING DOG
DIAMOND WHEEL DRESSER	DEAD CENTER
UNIVERSAL CHUCK	CENTER GAGE
GRINDING WHEEL	

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, GRINDING, PP. 33-1 TO 33-15, REF. #2, GRINDING, PP. 565-582. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND /OR TASKS:

X-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
X-C-1(TS).	SET UP UNIVERSAL CHUCK, SAME AS LATHE.
X-A-1b(TS)	SET UP TAILSTOCK.
X-C-1a(TS)	GRIND #3 MORSE TAPER.
X-D-1(TS)	ROTATE HEADSTOCK TO 30° AND GRIND POINT.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

TASK: ROTATE HEADSTOCK TO 30° AND GRIND POINT

JOB: LATHE CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, GRINDING WHEEL, 6" RULE, 0-1" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP HEADSTOCK	1. REMOVE UNIVERSAL CHUCK 2. LOOSEN LOCKING NUTS ON HEADSTOCK 3. ROTATE HEADSTOCK 30° 4. TIGHTEN LOCKING NUTS
2. DRESS WHEEL	1. PUT SAFETY GOGGLES ON 2. IF NECESSARY SHARPEN WHEEL (REFER TO: X-A-1a(TS) SPOTFACER BAR)
3. GRIND 30° POINT	1. GRIND 30° POINT BY PLUNGE METHOD 2. CENTER WORK PIECE ON FACE OF GRINDING WHEEL 3. LOCK TABLE 4. HAND FEED WHEEL INTO WORK PIECE NOTE: HOLD DIMENSION J, 7/32", AND H, 7/16"
4. DEBURR	USE HONE TO BREAK SHARP EDGES
5. INSPECT	1. .958" DIAMETER 2. .938" DIAMETER 3. .778" DIAMETER 4. 11/16" DIAMETER 5. 1/4" LENGTH 6. 3 5/16" LENGTH 7. 3/16" LENGTH 8. 7/16" LENGTH 9. UNDERCUT 10. FINISH

6. CLEAN MACHINE (REFER TO: X-A-1c(TS)

SKETCHES: DRAWING #6: LATHE CENTER

REFERENCE: REF. #2, P. 567

MACHINE SHOP SPUR CENTER

ENGINE LATHE	6
HORIZONTAL MILL	4
DRILL PRESS	1
HEAT TREAT	4
CYLINDER GRINDER	5

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A SPUR CENTER ACCORDING TO SPECIFICATIONS; USING MACHINES, PROCESSES, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

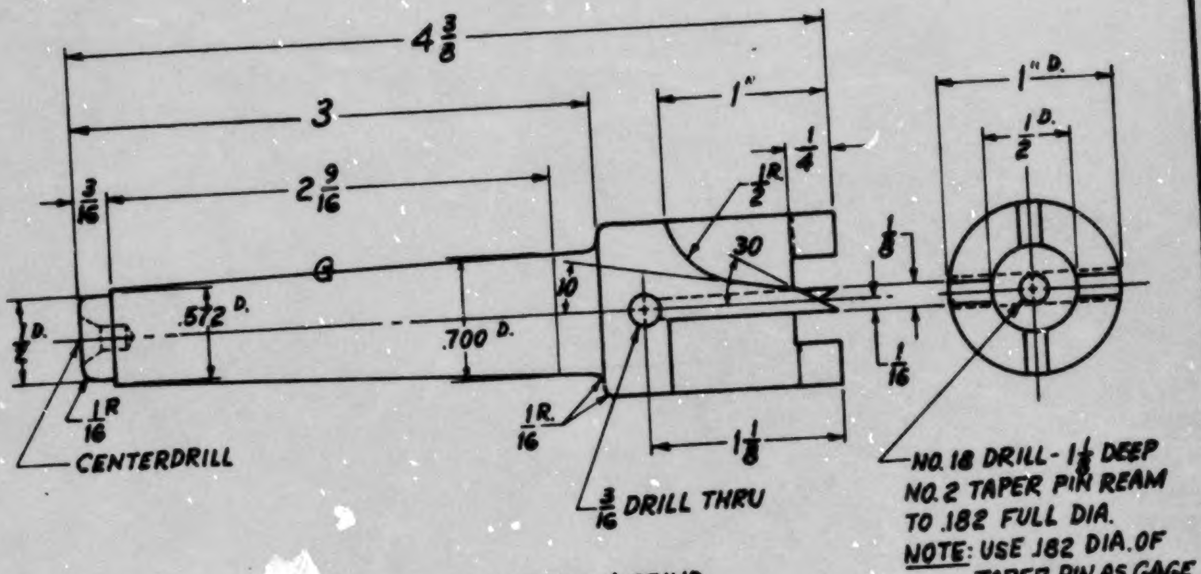
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR THE JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD SURFACE TO STANDARDS OF CRAFTSMANSHIP.
6. HOLD ALL SURFACES TO PRECISION FINISH.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

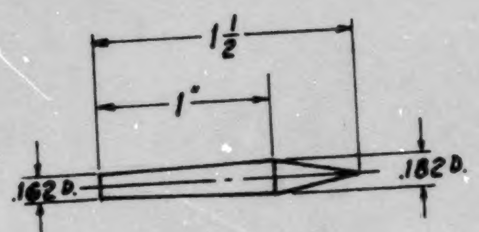
REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS


$4\frac{3}{8}$
3
$2\frac{9}{16}$
$\frac{3}{16}$
1"
$\frac{1}{4}$
$\frac{1}{2}$R
30
G
10
$\frac{1}{2}$ D.
.572 D.
.700 D.
$\frac{1}{16}$R
CENTERDRILL
$\frac{1}{16}$R.
$1\frac{1}{8}$
$\frac{3}{16}$ DRILL THRU
$\frac{1}{8}$
$\frac{1}{16}$
1" D.
$\frac{1}{2}$ D.
NO. 18 DRILL - $1\frac{1}{8}$ DEEP
NO. 2 TAPER PIN REAM
TO .182 FULL DIA.
NOTE: USE .182 DIA. OF
TAPER PIN AS GAGE

HARDEN & GRIND

GRINDING TOLERANCE ±.0002


$1\frac{1}{2}$
1"
.162 D.
.182 D.

TAPER PIN DETAIL

DRAWING NO. 7	SPUR CENTER	TOLERANCES UNLESS OTHERWISE NOTED
ENGINE LATHE JOB NO. 6 MILLING JOB NO. 4 DRILL PRESS JOB NO. 1 HEAT TREAT JOB NO. 4 CYL. GRINDER JOB NO. 5	MATERIAL: TOOL STEEL FINISH: GRIND SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .002" ANGLES - ± 1/4°

VII-G-1(J)

JOB SHEET
IN
ENGINE LATHE

JOB: SPUR CENTER

MATERIAL: 1 1/16" X 4 7/16" TOOL STEEL

TOOLS AND EQUIPMENT:

ENGINE LATHE
UNIVERSAL CHUCK
FACE PLATE
TAILSTOCK CHUCK AND KEY
CENTERDRILL
FACING TOOLS
10" MILL FILE
#2 TAPER PIN REAMER
TURNING TOOLS
DEAD CENTER
LIVE CENTER
LATHE DOG
0-1" MICROMETER
1-2" MICROMETER
6" RULE
#18 DRILL
1/2" DRILL

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, PP. 36-1 TO 36-44, REF. #2, LATHES, PP. 462-494. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
VII-C-1(TS)	SET UP, FACE, AND CENTERDRILL BOTH ENDS. HOLD TO 4 3/8" LENGTH.
VII-B-1d(TS)	SET UP AND TURN DIAMETER. HOLD TO 1".
VII-B-1d(TS)	SET UP AND TURN 1/2" DIAMETER X 3/16" LENGTH.
VII-G-1(TS)	SET UP AND TURN #2 MORSE TAPER. (SAME METHOD AS #3 MORSE TAPER.) HOLD .592" DIAMETER AT END AND .720" DIAMETER 2 9/16" FROM END. HOLD 2 13/16" LENGTH TO SHOULDER. NOTE: THIS LEAVES .020" GRINDING STOCK.
VII-E-1(TS)	SET UP AND TURN OR FILE 1/16" RADII.
VII-G-1a(TS)	SET UP AND DRILL #18 HOLE AND REAM.
VII-G-1b(TS)	SET UP AND DRILL 1/2" DIAMETER X 1/4" DEEP HOLE AND BORE.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUPS.

3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET VII-G-1(TS)

TASK: SET UP AND TURN #2 MORSE TAPER

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, UNIVERSAL CHUCK, FACE PLATE, TAILSTOCK CHUCK AND KEY, TURNING TOOLS, DEAD CENTER, LIVE CENTER, LATHE DOG, 10" MILL FILE, WORK PIECE, 0-1" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
	NOTE: SAME METHOD AS #3 MORSE TAPER
1. SET WORK BETWEEN CENTERS	(REFER TO: VII-B-1g(TS) GO AND NO-GO GAUGE)
2. TAPER ATTACHMENT	(REFER TO: VII-B-1h(TS) SPOTFACER BAR)
3. DIAMETER	1. HOLD SMALL DIAMETER TO .592" 2. 2 9/16" FROM SHOULDER HOLD DIAMETER TO .720"
4. LENGTH	2 13/16" TO SHOULDER
	NOTE: DIMENSIONS GIVEN LEAVES .020" GRINDING STOCK

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 172-178

TASK SHEET

VII-G-1a(TS)

TASK: SET UP AND DRILL #18 HOLE AND REAM

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, #2 TO #3 MORSE TAPER SLEEVE, TAILSTOCK CHUCK AND KEY, #18 DRILL, #2 TAPER PIN REAMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK	1. REMOVE FACE PLATE 2. CLEAN HEADSTOCK SPINDLE TAPER 3. INSERT TAPERED SLEEVE 4. INSERT WORK PIECE INTO SLEEVE, SMARTLY
2. SET UP TAILSTOCK	1. REMOVE LIVE CENTER FROM TAILSTOCK 2. SET UP DRILL CHUCK 3. SET UP #18 DRILL IN CHUCK
3. SET SPEED	SEE CHART, REF. #1, PP. 36-14 OR REF. #2, P. 468
4. DRILL HOLE	1. PUT SAFETY GOGGLES ON 2. DRILL HOLE 1 1/8" DEEP
5. REAM	REAM HOLE (REFER TO: VII-D-1a(TS) PLUG GAUGE HANDLE)

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, P. 36-35
REF. #2, P. 485

TASK SHEET

VII-G-1b(TS)

TASK: SET UP AND DRILL 1/2" DIAMETER X 1/4" DEEP HOLE AND BORE

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 1/2" DRILL, BORING BAR, COUNTER-BORE, OR INSIDE TURNING TOOL AND ACCESSORIES, WORK PIECE, TAILSTOCK CHUCK AND KEY, INSIDE CALIPERS, 0-1" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TAIL STOCK	MOUNT 1/2" DRILL IN CHUCK
2. SET SPEED	1. SLOW RPM 2. SEE CHART REF. #1, P. 36-14 REF. #2, P. 468
3. DRILL HOLE	1. 1/2" DIAMETER 2. 1/4" DEEP NOTE: DEPTH OF HOLE IS MEASURED FROM POINT OF DRILL
4. BORE HOLE	NOTE: 1/2" DRILL WILL LEAVE 60° ANGLE INSIDE END OF WORK PIECE. DRAWING REQUIRES SQUARE SHOULDERS AT 1/4" DEPTH 1. ON SHORT LENGTHS A HOLE MAY BE BORED BY USING: a. TURNING TOOL b. BORING BAR c. COUNTER BORE NOTE: CHECK WITH INSTRUCTOR FOR RECOMMENDED PROCEDURE 2. REMOVE INSIDE SHOULDER 3. HOLD SAME DIMENSIONS a. 1/2" DIAMETER b. 1/4" DEPTH

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, PP. 36-34 TO 36-35
REF. #2, PP. 485-486

VII-G-2(J)

JOB SHEET
ON
ENGINE LATHE

JOB: SPUR CENTER

MATERIALS:
TAPER - 3/16" X 1 5/8" DRILL ROD
FIXTURE - 1/2" X 1 9/16" COLD ROLL ROUND

TOOLS AND EQUIPMENT: ENGINE LATHE, UNIVERSAL CHUCK, TAILSTOCK DRILL CHUCK AND KEY, 5/32" DRILL, #18 DRILL, TAPER PIN REAMER, 0-1" MICROMETER, 6" RULE, MILL FILE, FACING TOOL, TURNING TOOL, CENTER DRILL, SMALL PUNCH, BALL PEEN HAMMER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1 LATHES, 36-1 TO 36-44, REF. #2, LATHES, 462 TO 494. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES

PROCEDURE AND/OR TASKS:

VII-B-1(TS)	CHECK ENGINE LATHE FOR PROPER OPERATING CONDITION
VII-G-2(TS)	MAKE TAPER PIN AND SPECIAL FIXTURE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITIONS
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-G-2(TS)

TASK: MAKE TAPER PIN

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, UNIVERSAL CHUCK, TAILSTOCK CHUCK AND KEY, 5/32" DRILL, #18 DRILL, TAPER PIN REAMER, 0-1" MICROMETER, 6" RULE, MILL FILE, FACING TOOLS, TURNING TOOLS, CENTERDRILL, 3/16" X 1 9/16" DRILL ROD FOR PIN, 1/2" X 1 9/16" COLD ROLL FOR SPECIAL FIXTURE, SMALL PUNCH, BALL PEEN HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE	1. SET UP DRILL ROD IN CHUCK WITH 1 1/16" PROTRUDING FROM END OF JAWS
	2. TIGHTEN CHUCK
2. SET UP TURNING TOOL	1. SET UP TURNING TOOLS IN TOOL POST
	2. TIGHTEN TOOL POST
3. TURN TAPER	1. SET UP TAPER ATTACHMENT FOR .020" PER INCH VII-B-1h(TS)
	2. TURN MACHINE ON
	3. TURN TAPER AND HOLD .162" AT SMALL END AND .182" 1" FROM END
	4. REMOVE WORKPIECE AND DEBURR
4. SET UP TO BUILD SPECIAL FIXTURE	1. SET UP FIXTURE MATERIAL IN CHUCK WITH 1/2" PROTRUDING
	2. TIGHTEN CHUCK
5. BUILD SPECIAL FIXTURE	1. SET UP, FACE, AND CENTERDRILL
	2. REMOVE CENTERDRILL
	3. SET UP 5/32" DRILL
	4. DRILL 5/32" HOLE THROUGH
	5. REMOVE 5/32" DRILL
	6. SET UP #18 DRILL
	7. DRILL #18 HOLE 1 1/8" DEEP
	8. REMOVE DRILL
	9. TAPER REAM HOLE

6. TURN TAPER	1. INSERT TAPER PIN INTO FIXTURE SMARTLY 2. SET UP TAPER ATTACHMENT ON 10° 19' ANGLE VII-B-1h(TS) 3. TURN TAPER TO A POINT AND HOLD 1/2" LENGTH
7. REMOVE TAPER PIN	1. REMOVE FIXTURE 2. REMOVE TAPER PIN WITH SMALL PUNCH
8. CLEAN MACHINE	
9. ROUTE TO HORIZONTAL MILL	

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, P. 36-35

IX-D-1(J)

JOB SHEET
IN
HORIZONTAL MILLING MACHINE

JOB: SPUR CENTER

MATERIALS: MACHINED TOOL STEEL WORK PIECE, LAYOUT INK

TOOLS AND EQUIPMENT:

HORIZONTAL MILLING MACHINE
ARBOR AND COLLARS
DIVIDING HEAD
TAPER SLEEVE
4" SIDE MILLING CUTTER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, MILLING, PP. 38-1 TO 38-38, REF. #2, MILLING, PP. 524-564. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION.
IX-D-1(TS)	SET UP DIVING HEAD AND WORK PIECE.
IX-D-1a(TS)	SET UP MILLING MACHINE.
IX-D-1b(TS)	MACHINE WORK PIECE.

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUPS.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

IX-D-1(TS)

TASK:	SET UP DIVIDING HEAD AND WORK PIECE
JOB:	SPUR CENTER
TRADE:	MACHINIST
TOOLS AND MATERIALS:	HORIZONTAL MILLING MACHINE, DIVIDING HEAD, TWO TABLE BOLTS, PROPER WRENCHES

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP DIVIDING HEAD	1. LOOSEN DIVIDING HEAD SWIVEL LOCKING NUTS 2. RAISE HEAD 10° 3. TIGHTEN SWIVEL LOCKING NUTS
2. BOLT TO TABLE	1. SET DIVIDING HEAD ON MILL TABLE 2. BOLT TO TABLE
3. SET UP WORK PIECE	1. WIPE FEMALE TAPER IN DIVIDING HEAD CLEAN 2. WIPE TAPERED SLEEVE CLEAN 3. INSERT TAPERED SLEEVE INTO DIVIDING HEAD SMARTLY 4. INSERT WORKPIECE INTO SLEEVE SMARTLY

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, PP. 38-20, 21
REF. #2, P. 536

TASK SHEET

IX-D-1a(TS)

TASK: SET UP MILLING MACHINE

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE WITH DIVIDING HEAD AND WORKPIECE SET UP, 1" END MILL, END MILL HOLDER, 0-1" MICROMETER, 6" RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP END MILL	1. CLEAN FEMALE TAPER IN MACHINE SPINDLE 2. CLEAN END MILL HOLDER NOTE: END MILL WILL BE MOUNTED IN HORIZONTAL HEAD 3. MOUNT END MILL HOLDER IN SPINDLE. (REFER TO: IX-B-1b(TS) SPOTFACER BAR) 4. MOUNT 1" END MILL
2. SET SPEED AND FEED	SEE REF. #1, P. 38-16 OR REF. #2, P. 549-550
3. SET TABLE STOPS	SET STOPS TO WHERE AUTOMATIC FEED DISENGAGES TO HOLD 1" FROM END

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, PP. 38-31, 32
REF. #2, P. 539

TASK SHEET

IX-D-1b(TS)

TASK: MACHINE WORK PIECE

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILL AS PREVIOUSLY SET UP, 0-1" MICROMETER, 6" RULE, 4" SIDE MILLING CUTTER, ARBOR AND COLLARS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION CUTTER	ADJUST TABLE TO PROPER POSITION FOR CUTTING NOTE: END OF END MILL SHOULD BE 1/16" FROM CENTER OF WORK PIECE AND BOTTOM OF END MILL SHOULD BE 1/16" FROM CENTER OF WORK PIECE IN OPPOSITE DIRECTION. (REFER TO: IX-B-1b(TS) SPOTFACER BAR) FOR PROPER SETTING PROCEDURE
2. MACHINE SPURS	1. PUT GOGGLES ON 2. START MACHINE 3. ENGAGE AUTOMATIC FEED NOTE: CUT UNTIL 1" FROM END 4. TURN TABLE LONGITUDINAL HAND WHEEL TO MOVE WORK AWAY FROM CUTTER 5. TURN DIVIDING HEAD HANDLE TO ROTATE WORK PIECE EXACTLY TEN ROUNDS OR 90° 6. REPEAT SAME PROCEDURE TO CUT SECOND SPUR 7. CUT SPURS 3 AND 4 IN SAME MANNER
3. SET UP SIDE MILLING CUTTER	1. REMOVE END MILL 2. REMOVE END MILL HOLDER 3. SET UP ARBOR. (REFER TO: IX-A-1a (TS) FLAT HEAD MACHINE SCREW 4. SET UP 4" SIDE MILLING CUTTER. (REFER TO: IX-A-1b(TS) FLAT HEAD MACHINE SCREW)

4. SET UP DIVIDING HEAD	1. LOOSEN SWIVEL LOCKING NUTS ON DIVIDING HEAD 2. SET DIVIDING HEAD ON 30° ANGLE 3. TIGHTEN LOCKING NUTS
5. POSITION CUTTER	POSITION BOTTOM OF CUTTER OVER END OF SPUR
6. MACHINE SPUR END	1. TURN MACHINE ON 2. PICK UP SIDE OF SPUR WITH SIDE OF CUTTER NOTE: USE PAPER BETWEEN CUTTER AND WORK PIECE 3. MACHINE END TO SPUR TO SHARP EDGE NOTE: NO DIMENSIONS, ONLY SHARP EDGE 4. ROTATE DIVIDING HEAD 90° AND REPEAT SAME PROCEDURE ON OTHER THREE SPURS
7. DEBURR	REMOVE ALL MACHINE BURRS WITH FILE EXCEPT SHARP EDGE ON END OF SPURS
8. INSPECT	CHECK ALL DIMENSIONS TO DRAWING SPECIFICATIONS
9. CLEAN MACHINE	(REFER TO: IX-A-1c(TS) FLAT HEAD MACHINE SCREW)

ROUTE TO DRILL PRESS

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, P. 38-20 TO 38-28
REF. #2, P. 536

VI-A-1(J)

JOB SHEET IN DRILL PRESS

JOB: SPUR CENTER

MATERIAL: AS MACHINED ON LATHE AND HORIZONTAL MILL

TOOLS AND EQUIPMENT:

- DRILL PRESS
- DRILL PRESS VISE
- CHUCK AND KEY
- 3/16" DRILL
- OIL CAN WITH OIL
- LAYOUT INK
- SCRIBER
- 6" RULE
- CENTERPUNCH
- BALL PEEN HAMMER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 34-1 TO 34-24, REF. #2, PP. 203 TO 219. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

IV-B-1(TS)	LAYOUT WORK PIECE
VI-A-1(TS)	CHECK DRILL FOR PROPER RUNNING CONDITION
VI-A-1a(TS)	SET UP AND DRILL 3/16" HOLE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

IV-B-1(TS)

TASK: LAYOUT WORK PIECE

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: LAYOUT INK, SCRIBER, 6" RULE, CENTERPUNCH, SMALL BALL PEEN HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SCRIBE LINE	1. PUT LAYOUT INK ON WORK PIECE IN AREA TO BE DRILLED 2. SCRIBE LINE ACROSS DIAMETER 1 1/8" FROM END OF SPURS 3. SCRIBE SECOND LINE ACROSS FIRST
2. CENTER PUNCH	CENTER PUNCH IN CENTER OF CROSS

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, P. 6-8
REF. #2, PP. 51, 52

TASK SHEET

VI-A-1(TS)

TASK:	CHECK DRILL PRESS FOR PROPER RUNNING CONDITION
JOB:	SPUR CENTER
TRADE:	MACHINIST
TOOLS AND MATERIALS:	DRILL PRESS, OILER WITH OIL IF NECESSARY

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOTOR	1. PROPER GROUNDING 2. ON AND OFF SWITCH FUNCTION PROPERLY
2. TABLE	1. PROPER HEIGHT 2. LEVEL 3. LOCKED IN PLACE 4. CLEAN
3. SPEED	1. 600 RPM 2. PROPER BELT TENSION 3. PULLEY COVERS OR GUARDS IN PLACE
4. FEED	1. FEED LEVER IN OPERATION 2. DEPTH-STOP PROPERLY ADJUSTED
5. LUBRICATION	1. OIL DAILY 2. ONE OR TWO DROPS IN EACH OIL HOLE

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, PP. 34-1 TO 34-24
REF. #2, PP. 203-228

TASK SHEET

VI-A-1a(TS)

TASK:	SET UP AND DRILL 3/16" HOLE
JOB:	SPUR CENTER
TRADE:	MACHINIST
TOOLS AND MATERIALS:	DRILL PRESS, CHUCK AND KEY, 3/16" DRILL, DRILL VISE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP DRILL	1. MOUNT DRILL CHUCK IN SPINDLE NOTE: BE SURE BOTH ARE CLEAN
	2. MOUNT 3/16" DRILL IN CHUCK
	3. TIGHTEN CHUCK WITH KEY
2. SET UP WORK	1. MOUNT WORK PIECE IN VISE
	2. CENTER PUNCH UP
	3. TIGHTEN VISE
3. DRILL HOLE	1. PUT GOGGLES ON
	2. START MACHINE
	3. POSITION WORK PIECE CENTER PUNCH UNDER DRILL POINT
	4. DRILL 3/16" HOLE THROUGH WORK PIECE NOTE: WHEN DRILL POINT ENTERS TAPERED HOLE IN CENTER, FEED VERY SLOWLY SO DRILL WILL NOT START DRILLING AT AN ANGLE NOTE: BE SURE TO DRILL THROUGH CENTER LINE OF WORKPIECE
4. DEBURR	REMOVE BURRS WITH FILE
5. INSPECT	1. CHECK DIAMETER OF HOLE
	2. CENTERLINE
6. CLEAN UP	1. WIPE MACHINE CLEAN
	2. RETURN ALL TOOLS TO PROPER PLACE
	3. DISPOSE OF WASTE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES: REF. #1, PP. 34-9 TO 34-16
REF. #2, P. 210

JOB SHEET
IN
HEAT TREAT

JOB: SPUR CENTER

MATERIALS: AS MACHINED ON THE LATHE, HORIZONTAL MILL, AND DRILL PRESS

TRADE: MACHINIST

TOOLS AND EQUIPMENT:
HEAT TREAT FURNACE
TONGS
SAFETY CLOTHING
FIRE EXTINGUISHER
QUENCHING VAT WITH WATER OR OIL

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 31-1 TO 31-8, REF. #2, PP. 357 TO 369. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

XI-A-1(TS)	CHECK FURNACE FOR PROPER OPERATING CONDITION.
XI-A-1b(TS)	HEAT TREAT WORK PIECE TO PROPER HARDNESS AND INSPECT.
XI-A-1b(TS)	CLEAN UP AREA

ROUTE TO CYLINDER GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK FURNACE FOR PROPER OPERATING CONDITION.
2. TEST HARDNESS.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

X-E-1(J)

JOB SHEET
IN
CYLINDRICAL GRINDING

JOB:	SPUR CENTER
MATERIAL:	AS MACHINED ON THE LATHE, HORIZONTAL MILL, DRILL PRESS, AND HEAT TREATED
TRADE:	MACHINIST
TOOLS AND EQUIPMENT:	CYLINDRICAL GRINDER, DIAMOND DRESSER, UNIVERSAL CHUCK, DEAD CENTER, 0-1" MICROMETER, 6" RULE, HONE
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, PP. 33-1 TO 33-15, REF. #2, PP. 565 TO 582. STUDY JOB AND TASK SHEETS. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.
PROCEDURES AND/OR TASKS:	X-A-1(TS) CHECK MACHINE FOR PROPER OPERATING CONDITION. X-E-1(TS) SET UP AND GRIND TAPER.
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. CHECK MACHINE FOR PROPER OPERATING CONDITION. 2. CHECK MACHINE FOR PROPER SETUP. 3. ALL DIMENSIONS HELD TO SPECIFICATIONS. 4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

X-E-1(TS)

TASK: SET UP AND GRIND TAPER

JOB: SPUR CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, DIAMOND DRESSER, UNIVERSAL CHUCK, DEAD CENTER, 0-1" MICROMETER, 6" RULE, HONE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. DRESS WHEEL	DRESS WHEEL IF NECESSARY WITH 1/16" RADII ON LEFT EDGE. (REFER TO: X-A-1a(TS) SPOTFACER BAR)
2. SET UP MACHINE	SET UP UNIVERSAL CHUCK (SAME AS LATHE)
3. SET UP WORK	1. MOUNT SPUR END IN CHUCK 2. SET UP TAILSTOCK WITH DEAD CENTER 3. ADJUST TO WORK PIECE (REFER TO: X-C-1(TS) GO AND NO-GO GAUGE) 4. SET TRAVERSING DOGS. (REFER TO: X-A-1b(TS) TAPER PLUG GAUGE)
4. GRIND TAPER	GRIND #2 MORSE TAPER SAME AS #3 MORSE TAPER NOTE: HOLD .572" DIAMETER AT SMALL END AND .700" DIAMETER 2 9/16" FROM SMALL END SHOULDER
5. DEBURR	BREAK ALL SHARP EDGES WITH HONE
6. INSPECT	CHECK ALL DIMENSIONS ACCORDING TO DRAWING SPECIFICATIONS
7. CLEAN MACHINE	(REFER TO: X-A-1c(TS) SPOTFACER BAR)

SKETCHES: DRAWING #7: SPUR CENTER

REFERENCES:
REF. #1, P. 33-5
REF. #2, P. 567
REF. #3, PP. 304-305

MACHINE SHOP CUP CENTER

ENGINE LATHE 7

DRILL PRESS 2

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A CUP CENTER ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

CHECKING STANDARDS

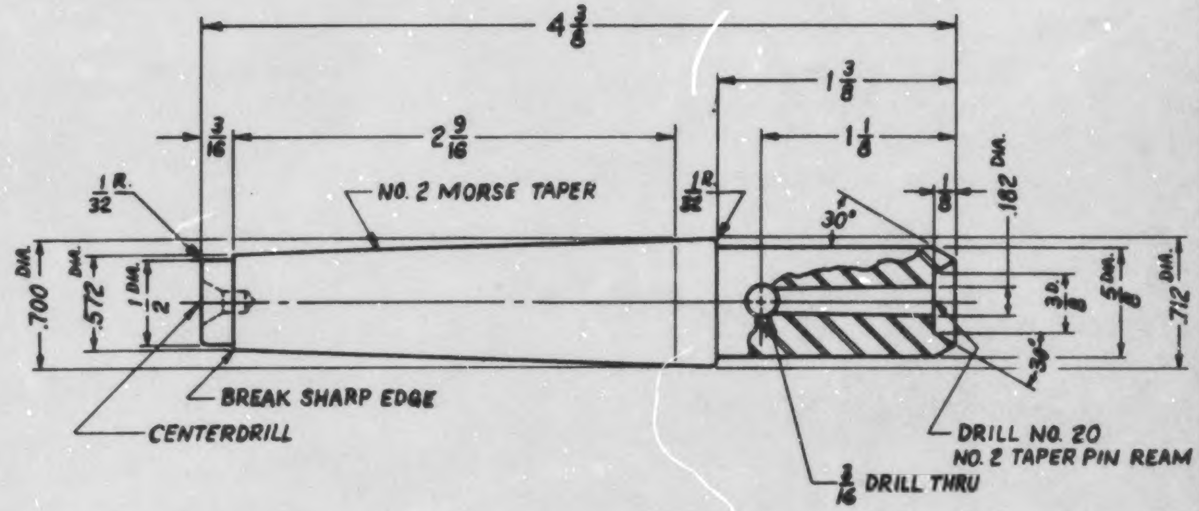
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWINGS.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, AND EQUIPMENT.
8. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METAL WORKING

REF. #2, LUDWIG, OSWALD A. AND WILLIAM J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS



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$1\frac{3}{8}$
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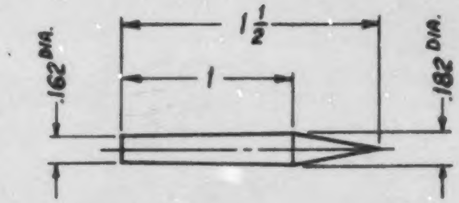
$\frac{1}{32}$ R.
$\frac{1}{32}$ R.
NO. 2 MORSE TAPER
30°
$\frac{1}{8}$
.182 DIA.
.700 DIA.
.572 DIA.
$\frac{1}{2}$ DIA.
$\frac{3}{8}$ D.
$\frac{5}{8}$ DIA.
.712 DIA.
30°
BREAK SHARP EDGE
CENTERDRILL
DRILL NO. 20
NO. 2 TAPER PIN REAM
$\frac{3}{16}$ DRILL THRU



$1\frac{1}{2}$
1
.162 DIA.
.182 DIA.

TAPER PIN DETAIL

DRAWING NO. 8	CUP CENTER	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 7 DRILL PRESS JOB NO. 2 BENCH JOB NO. 3	MATERIAL: TOOL STEEL FINISH: POLISH SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .002" ANGLES - ± 1/4 °

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE CUP CENTER

MATERIAL: 3/4" X 4 7/16" ROUND TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, UNIVERSAL CHUCK, FACE PLATE, TAILSTOCK CHUCK AND KEY, CENTERDRILL, FACING TOOLS, TURNING TOOLS, DEAD CENTER, LIVE CENTER, LATHE DOG, 0-1" MICROMETER, DIAL INDICATOR, 6" RULE, MILL FILE, #18 DRILL, 30° COUNTERBORE, DRILL PRESS, LAYOUT TOOLS, CENTERPUNCH, BALL PEEN HAMMER, DRILL CHUCK AND KEY, DRILL PRESS VISE, DEPTH MICROMETER, #2 TO #3 TAPER SLEEVE, SPECIAL TAPER PIN FIXTURE—SEE JOB #7.

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCES: #1 LATHES, PP. 36-1 TO 36-44, DRILL PRESS, PP. 34-1 TO 34-24. #2, LATHES, PP. 462-494, DRILL PRESS, PP. 219-230. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL BOTH ENDS NOTE: HOLD WORK PIECE TO 4 3/8" LENGTH
VII-B-1d(TS)	SET UP AND TURN 1/2" DIAMETER X 3/16" LENGTH
VII-B-1d(TS)	SET UP AND TURN 5/8" DIAMETER X 1 3/8" LENGTH
VII-F-1a(TS)	SET UP AND TURN 30° X 1/8" CHAMFER NOTE: HOLD 3/8" DIAMETER
VII-G-1(TS)	SET UP AND TURN #2 MORSE TAPER NOTE: HOLD .572" DIAMETER AT END AND .700" DIAMETER 2 9/16" FROM SHOULDER
VII-B-1f(TS)	SET UP AND TURN 1/32" RADII
VII-D-1(TS)	SET UP AND DRILL #18 HOLE
VII-D-1a(TS)	SET UP AND REAM #2 PIN TAPER
VII-H-1(TS)	SET UP AND COUNTERBORE NOTE: SEE TASK SHEET

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS.

1. PROPER MACHINE SET UP AND OPERATING CONDITION.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.

3. CRAFTSMANLIKE PERFORMANCE.
4. APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS.
5. SAFE WORKING HABITS.

TASK SHEET

VII-H-1(TS)

TASK: SET UP AND COUNTERBORE

JOB: CUP CENTER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, #2 TO #3 TAPER SLEEVE, TAILSTOCK CHUCK AND KEY, 30° COUNTERBORE, DEPTH MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP COUNTERBORE	1. INSERT 30° COUNTERBORE IN DRILL CHUCK 2. TIGHTEN WITH KEY
2. SET MACHINE	PLACE MACHINE IN BACKGEAR
3. COUNTERBORE	1. COUNTERBORE SAME AS CENTER DRILL 2. HOLD 1/8" DEEP X 3/8" DIAMETER
4. DEBURR	USE FILE
5. INSPECT	CHECK ALL DIMENSIONS ON BOTH PIECES TO DRAWING SPECIFICATIONS
6. CLEAN UP LATHE	(REFER TO: VII-A-1c(TS) SPOTFACER BAR)

ROUTE WORK TO DRILL PRESS

SKETCHES: DRAWING #8: CUP CENTER

REFERENCES: REF. #1, P. 34-19
REF. #2, P. 485

VII-H-2(J)

JOB SHEET
IN
ENGINE LATHE

JOB: TAPER PIN

MATERIALS: TAPER PIN-3/16" X 1 5/8" DRILL ROD

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 3/16" COLLET, TURNING TOOLS, 0-1" MICROMETER, 6" RULE, SPECIAL FIXTURE AS INDICATED IN JOB #7, SPUR CENTER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, 36-1 TO 36-44, REF. #2, LATHES, 462 TO 494. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES. SECURE TASK SHEETS FROM

PROCEDURES AND/OR TASKS: (REFER TO: VII-G-1c(TS), AND FOLLOW ALL TASKS ON CONSTRUCTING A TAPER PIN. HOLD ALL DIMENSIONS GIVEN

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUPS.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

VI-B-1 (TS)

JOB SHEET
ON
DRILL PRESS

JOB: CUP CENTER

MATERIALS: FINISH TURNED WORKPIECE AS PER DRAWING #8

TOOLS AND EQUIPMENT: DRILL PRESS, CHUCK AND KEY, V-BLOCKS AND CLAMP, SCRIBE, 6" RULE, CENTER PUNCH, BALL PEEN HAMMER, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCES: #1, DRILL PRESS, PP. 34-1 TO 34-24; REF. #2, DRILL PRESS, PP. 219-230 CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

IV-B-1 (TS)	LAYOUT AND LOCATE CENTER FOR 3/16" DRILLED HOLE
VI-A-1 (TS)	CHECK DRILL PRESS FOR PROPER OPERATING CONDITION
VI-A-1a (TS)	SETUP WORKPIECE AND DRILL 3/16" HOLE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS.

1. PROPER MACHINE SET UP AND OPERATING CONDITION
2. ALL DIMENSIONS HELD TO SPECIFICATIONS
3. CRAFTSMANLIKE PERFORMANCE
4. APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS
5. SAFE WORKING HABITS

MACHINE SHOP — TOOL POST WEDGE

BAND SAW	1
BELT SANDER	1
SHAPER	1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A TOOL POST WEDGE ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

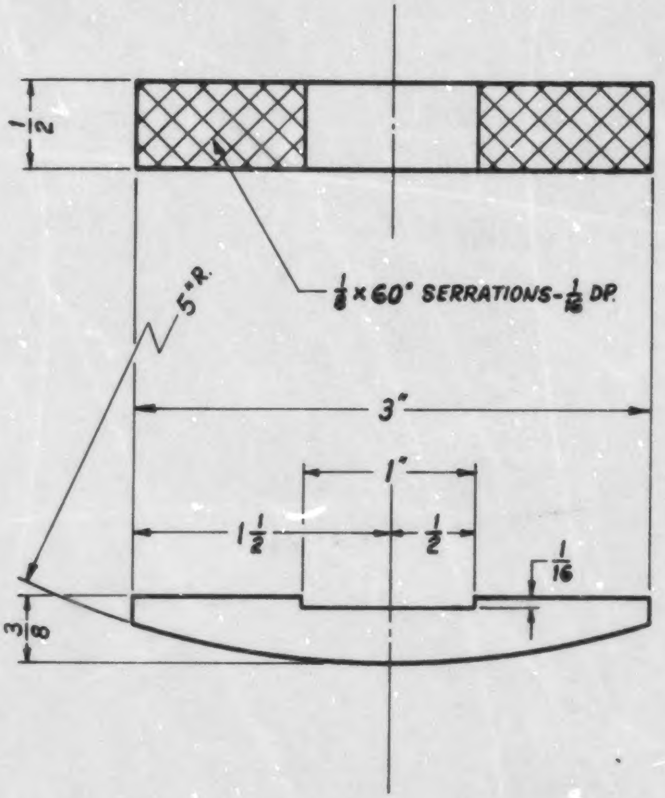
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINE FUNDAMENTALS

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REFERENCE #2 ON DRAWING #9. IF OTHER SIZES ARE TO BE MADE, DIMENSIONS MUST BE CHANGED ACCORDINGLY.


1/2
1/8 × 60° SERRATIONS-1/16 DP.
5"R.
3"
1"
1 1/2
1/2
1/16
3/8

DRAWING NO. 9	**TOOL POST WEDGE**	**TOLERANCES UNLESS OTHERWISE NOTED**
*BAND SAW JOB NO. 1 *SHAPER JOB NO. 1 *BELT SANDER JOB NO. 1, OR... HORIZONTAL MILL JOB NO. 5	**MATERIAL:** C.R. STEEL **FINISH:** TOOL **SCALE:** HALF 158	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

V-A-1(J)

JOB SHEET
IN
BAND SAW

JOB: TOOL POST WEDGE

MATERIAL: 5/8" x 5/8" x 3 1/8" COLD ROLLED STEEL, LAYOUT INK

TOOLS AND EQUIPMENT: BAND SAW, METAL CUTTING BLADE, LAYOUT TOOLS, 6" RULE, SCRIBE, 0-1" MICROMETER, HEIGHT GAUGE, 5" RADII TEMPLATE, LAYOUT TABLE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCES: #1, SAWS, PP. 35-1 TO 35-6, #2, SAWS, PP. 90-100. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

IV-C-1(TS)	LAYOUT WORK PIECE
V-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
V-A-1a(TS)	SAW 5" RADII
V-A-1b(TS)	CLEAN MACHINE

ROUTE TO BELT SANDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. WORK PIECE LAYOUT.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, MATERIAL, AND STANDARDS.
6. SAFE WORKING HABITS.

TASK SHEET

IV-C-1(TS)

TASK:	LAYOUT WORK PIECE
JOB:	TOOL POST WEDGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	LAYOUT TABLE, INK, HEIGHT GAGE, 5" RADII, TEMPLATE SCRIBER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT RADII	1. INK WORK PIECE 2. SCRIBE 5" RADII ON 5/8" THICKNESS NOTE: TEMPLATE MAY BE USED. CHECK WITH INSTRUCTOR 3. CENTER OF RADII TO BE ON EDGE OF WORK PIECE
2. LAYOUT 1/2" WIDTH	LAYOUT 1/2" WIDTH NOTE: THIS DIMENSION WILL BE CUT LATER ON THE SHAPER
3. LAYOUT CENTER RELIEF	LAYOUT ONE INCH FROM EACH END AND 1/16" DEEP NOTE: THIS IS "D" DIMENSION ON THE DRAWING

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 50-59

TASK SHEET V-A-1(TS)

TASK: CHECK BAND SAW FOR PROPER OPERATING CONDITION

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL BAND SAW, 18 PITCH BLADE, OIL CAN WITH OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SAW BLADE	1. PROPER TYPE BLADE 2. BLADE CONDITION SHARP 3. PROPERLY INSTALLED a. TENSION b. TEETH POINTING IN RIGHT DIRECTION
2. GUARDS	1. IN PROPER POSITION 2. INSTALLED TIGHT
3. OIL	1. ONE OR TWO DROPS OIL IN OIL HOLES DAILY 2. FULL OF CUTTING OIL
4. SPEED	SET SPEED FOR 5/8" COLD ROLL FLAT

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 35-1 TO 35-6
REF. #2, PP. 90-100

TASK SHEET

V-A-1a(TS)

TASK: SAW 5" RADII

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL BAND SAW, 18 PITCH BLADE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SAW RADII	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. BAND SAW 5" RADII NOTE: BE CAUTIOUS OF HANDS NEAR SAW BLADE 4. SAW TO LAYOUT LINE NOTE: DO NOT PERMIT SAW BLADE TO CROSS LAYOUT LINE INTO WORK PIECE
2. DEBURR	USE FILE
3. INSPECT	ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CLEAN MACHINE	1. REMOVE CHIPS WITH BRUSH 2. WIPE MACHINE OFF 3. RETURN ALL TOOLS TO THEIR PROPER PLACE

ROUTE TO BELT SANDER

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 35-3,4
REF. #2, PP. 95-97

TASK SHEET V-A-1b(TS)

TASK: CLEAN BAND SAW

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: CHIP BRUSH, CLEAN SHOP TOWEL, OIL CAN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE WORK PIECE	1. CAREFULLY REMOVE FINISHED WORK PIECE FROM MACHINE. CAUTION: AVOID SHARP EDGE OR BURRS
	2. PLACE ALL SCRAP PIECES IN DISPOSAL CONTAINER
	3. PICK UP ANY SCRAP PIECES THAT MAY BE ON FLOOR
2. BRUSH MACHINE OFF	1. BRUSH ALL METAL SHAVINGS OFF OF MACHINE CAUTION: DO NOT USE HANDS
	2. BRUSH UNDERSIDE OF TABLE AND BLADE GUARD
3. WIPE MACHINE	1. REMOVE SMALL FILINGS WITH SHOP TOWEL OR RAG CAUTION: AVOID GETTING FILINGS IN HAND WHILE WIPING MACHINE
	2. FINISH WIPING WITH A CLEAN SHOP RAG
4. OIL MACHINE	1. WIPE A LIGHT FILM OF OIL ON TABLE AND EXPOSED MACHINED SURFACES ROUTE TO BELT SANDER OR GRINDER

SKETCHES: DRAWING #9 TOOL POST WEDGE

REFERENCES: REF. #1, PP. 35-3, 4
REF. #2, PP. 95,97

X-F-1(J)

JOB SHEET
IN
BELT SANDER

JOB: TOOL POST WEDGE

MATERIAL: WORK PIECE WITH 5" RADII SAWED

TOOLS AND EQUIPMENT: BELT SANDER, PROPER BELT, COOLANT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE: #3, SANDER, PP. 308-310. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASK:

X-F-1(TS)	CHECK BELT SANDER FOR PROPER OPERATING CONDITION
X-F-1a(TS)	SAND RADII
X-F-1b(TS)	CLEAN SANDER AND WORK STATION

ROUTE TO SHAPER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, MATERIALS, AND STANDARDS.
5. SAFE WORKING HABITS.

TASK SHEET X-F-1(TS)

TASK: CHECK SANDER FOR PROPER OPERATING CONDITION

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: BELT SANDER, PROPER BELT, COOLANT

TASK BREAKDOWN:

STEPS	KEY POINTS
1. BELT	1. PROPER BELT
	2. BELT PROPERLY INSTALLED
	3. TENSION ON BELT CORRECT
2. GUARDS	1. GUARDS IN PLACE
	2. GUARDS TIGHT
3. TABLE	1. TABLE SET LEVEL
	2. TABLE TIGHT
4. COOLANT	COOLANT TANK FILLED NOTE: SOME SANDERS ARE DRY GRINDERS. IF SO, BE SURE A CONTAINER OF WATER IS AVAILABLE TO COOL WORK PIECE

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #3, PP. 308-310

TASK SHEET

X-F-1a(TS)

TASK: SAND RADII AND ENDS

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: BELT SANDER, PROPER BELT, COOLANT, MILL FILE, 6" RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SAND RADII	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON 3. GRIND 5" RADII TO MINIMUM CLEAN UP NOTE: BE CAUTIOUS OF HANDS NEAR BELT. KEEP WORK PIECE FLAT ON TABLE 4. TURN MACHINE OFF
2. GRIND ENDS	1. TO CLEAN UP SAW MARKS 2. MAINTAIN 3" SPECIFICATION
3. DEBURR	USE FILE
4. INSPECT	1. RADII 2. 1/8" TWO PLACES
5. CLEAN MACHINE	1. WIPE MACHINE CLEAN 2. RETURN TOOLS TO THEIR PROPER PLACE

ROUTE TO SHAPER

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #3, PP. 308-310

VIII-A-1(J)

JOB SHEET
IN
SHAPER

JOB: TOOL POST WEDGE

MATERIAL: WORK PIECE SANDED, OIL

TOOLS AND EQUIPMENT: SHAPER, OIL CAN, SHAPER VISE, DIAL INDICATOR, TOOL HOLDER, RIGHT AND LEFT-HANDED CUTTING TOOLS WITH 1/16" RADII, PARALLELLBARS, LEAD HAMMER, SURFACE GAGE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCES: #1, SHAPER, PP. 37-1 TO 37-16, #2, SHAPER, PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

VIII-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VIII-A-1a(TS)	SET UP MACHINE AND WORK PIECE
VIII-A-1b(TS)	MACHINE DIMENSION "D"
VIII-A-1c(TS)	SETUP AND MACHINE 1/2" WIDTH
VIII-A-1d(TS)	SETUP AND MACHINE SERRATIONS
VIII-A-1e(TS)	CLEAN UP MACHINE AND WORK STATION

ALTERNATES:

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-E-1(TS)	SET UP MACHINE AND WORKPIECE
IX-E-1a(TS)	MACHINE DIMENSIONS "D"
IX-E-1b(TS)	SET UP AND MACHINE 1/2" WIDTH
IX-E-1c(TS)	SET UP AND MACHINE SERRATIONS
IX-A-1c(TS)	CLEAN UP MACHINE AND WORK STATION

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUPS.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINE, MATERIAL AND STANDARDS.
5. SAFE WORKING HABITS.

TASK SHEET

VIII-A-1(TS)

TASK:	CHECK MACHINE FOR PROPER OPERATING CONDITION
JOB:	TOOL POST WEDGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SHAPER, OIL CAN WITH OIL, OIL FOR RESERVOIR IF NECESSARY

TASK BREAKDOWN:

STEPS	KEY POINTS
1. OIL RESERVOIR	1. FILL TO PROPER RUNNING LEVEL 2. FLYWHEEL MUST RUN IN OIL
2. RAM WAY OILERS	1. FILL RAM WAY OILERS 2. ONE OR TWO DROPS OIL IN EACH OIL HOLE ON ENTIRE MACHINE
3. GUARDS	1. ALL GUARDS IN PLACE 2. TIGHTENED SECURELY

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499 TO 523

TASK SHEET

VIII-A-1a(TS)

TASK: SET UP MACHINE AND WORK PIECE

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, DIAL INDICATOR, TOOL HOLDER, RIGHT AND LEFT HAND CUTTING TOOLS WITH 1/16" RADII, PARALLEL BARS, LEAD HAMMER, SURFACE GAGE, WORKPIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP VISE	1. SET VISE JAWS PERPENDICULAR TO RAM 2. INDICATE TRUE NOTE; BE SURE VISE JAWS ARE WELL BELOW STROKE OF RAM
2. SET UP MACHINE	1. MOUNT TOOL HOLDER TO CLAPPER BOX 2. MOUNT TOOL IN HOLDER 3. SET LENGTH OF STROKE 1/2" BEFORE TOOL STARTS CUT AND 1" PAST CUT
3. SET SPEED AND FEED	SEE REF. #1, P. 37-7 OR REF. #2, PP. 505-506
4. SET UP WORK	1. WIPE VISE CLEAN 2. SET PARALLEL BAR IN VISE 3. SET RADII OF WORK PIECE ON PARALLEL BAR NOTE; PARALLEL BAR MUST NOT BE AS THICK AS WORK PIECE IS WIDE, AND MUST BE WIDE ENOUGH TO PERMIT AREA TO BE CUT TO BE ABOVE TOP OF VISE 4. SNUG VISE 5. LEVEL TOP OF WORK PIECE WITH SURFACE GAUGE AND DIAL INDICATOR 6. TIGHTEN VISE SECURELY

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 37-4 TO 37-11
REF. #2, PP. 502-513

TASK SHEET

VIII-A-1b(TS)

TASK:	MACHINE DIMENSION "D"
JOB:	TOOL POST WEDGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SHAPER, SHAPER VISE, TOOL HOLDER, CUTTING TOOL WITH 1/16" RADII, DEPTH MICROMETER, MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION WORK	1. PUT SAFETY GOGGLES ON 2. START MACHINE RAM 3. POSITION TABLE UNTIL POINT OF TOOL IS JUST OVER AREA TO BE CUT
2. CUT .060" RELIEF	1. RAISE TABLE BY HAND UNTIL TOOL TOUCHES WORK 2. RAISE TABLE .060" BY THE DIAL 3. ENGAGE AUTOMATIC FEED 4. CUT TO LAYOUT LINE 5. REVERSE AUTOMATIC FEED DIRECTION 6. CUT TO LAYOUT LINE 7. STOP MACHINE 8. REMOVE WORK PIECE
3. DEBURR	REMOVE MACHINE BURRS WITH FILE

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 37-4 TO 37-11
REF. #2, PP. 502-513

TASK SHEET

VIII-A-1c(TS)

TASK:	SET UP AND MACHINE 1/2" WIDTH
JOB:	TOOL POST WEDGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SHAPER, SHAPER VISE, LEAD HAMMER, PARALLEL BARS, 0-1" MICROMETER, MILL FILE, TOOL HOLDER, CUTTING TOOL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK	1. PLACE WORK PIECE IN VISE WITH LAYOUT LINE ABOVE TOP OF VISE 2. TIGHTEN VISE SECURELY 3. TAP TOP OF WORK PIECE WITH HAMMER TO BE SURE IT IS DOWN ON PARALLEL BARS EVENLY
2. CUT WIDTH	1. CUT TO LAYOUT LINE IN SAME MANNER AS BEFORE NOTE: HOLD 1/2" WIDE 2. STOP MACHINE 3. REMOVE WORK PIECE
3. DEBURR	USE FILE

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 37-4 TO 37-11
REF. #2, PP. 502-513

TASK SHEET

VIII-A-1d(TS)

TASK: SET UP AND MACHINE SERRATIONS

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, TOOL HOLDER, 60° POINT TOOL, PROPER VISE WRENCH, MILL FILE, PARALLEL BARS, LEAD HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TOOL	1. SET UP WORK PIECE SAME AS FOR RELIEF CUT 2. REMOVE TOOL 3. MOUNT 60° TOOL
2. SET UP VISE	1. LOOSEN VISE LOCKING NUTS 2. SWIVEL VISE TO 45° 3. TIGHTEN LOCKING NUTS
3. SET FEED	SET AUTOMATIC FEED TO CUT .125" BETWEEN CUTS NOTE: THIS IS WIDTH BETWEEN SERRATIONS
4. RESET STROKE	RESET LENGTH OF RAM STROKE 1/2" BEFORE TOOL STARTS TO CUT WORK PIECE CLOSEST TO COLUMN AND 1" PAST WORK PIECE AT FARTHEST POINT FROM COLUMN NOTE: WORK PIECE IS SET AT 45° ANGLE
5. CUT FIRST SERRATION	1. POSITION POINT OF TOOL AT POINT OF WORK PIECE CLOSEST TO COLUMN 2. RAISE TABLE .060" 3. START MACHINE 4. CUT SERRATIONS IN ONE DIRECTION ACROSS WORK PIECE 5. STOP MACHINE
6. RESET UP	1. LOOSEN VISE LOCKING NUTS 2. SWIVEL VISE 90°

6. RESET UP (CON'T)	3. TIGHTEN LOCKING NUTS
7. CUT SECOND SERRATION	1. CUT SERRATIONS SAME AS BEFORE 2. STOP MACHINE 3. REMOVE WORK PIECE
8. DEBURR	REMOVE MACHINE BURRS WITH FILE
9. INSPECT	CHECK ALL DIMENSIONS TO DRAWING SPECIFICATIONS
10. CLEAN MACHINE	1. WIPE MACHINE OFF WITH BRUSH 2. RETURN ALL TOOLS TO THEIR PROPER PLACE 3. DISPOSE OF WASTE

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 37-11, 12
REF. #3, PP. 220

TASK SHEET

VIII-A-1e(TS)

TASK:	CLEAN UP MACHINE
JOB:	TOOL POST WEDGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	CHIP BRUSH, WIPING RAGS, OIL CAN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE WORK PIECE	1. LOOSEN VISE
	2. REMOVE WORK PIEC CAREFULLY CAUTION: BURRS ON EDGE OF WORK PIECE WILL CUT
2. REMOVE SHAVINGS AND CHIPS	1. BRUSH CHIPS OFF VISE AND MACHINE CAUTION: DO NOT USE BARE HANDS
	2. SWEEP CHIPS INTO DUST PAN AND DISPOSE OF
3. WIPE MACHINE OFF	1. WIPE MACHINE AND VISE WITH SHOP TOWEL OR WIPING RAGS
	2. WIPE LIGHT FILM OF OIL ON MACHINE PART TO PREVENT RUST
4. SECURE TOOLS	1. PLACE TOOLS IN PROPER STORAGE
	2. PLACE OILY RAGS IN OILY RAG CONTAINER
	3. PLACE ALL TOOLING IN PROPER STORAGE

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499 TO 523

JOB SHEET
ON
MILLING MACHINE

JOB:	TOOL POST WEDGE
MATERIAL:	WORK PIECE SANDED
TOOLS AND EQUIPMENT:	HORIZONTAL MILL, ARBOR, COLLARS, MILL VISE, SIDE MILLING CUTTER, PARALLEL BAR, LEAD HAMMER, SURFACE GAGE, DIAL INDICATOR, DEPTH MICROMETER, 6" RULE, MILL FILE, 60° DOUBLE ANGLE CUTTER
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REFERENCES #1, PP. 38-1 TO 38-37, REFERENCE #2, PP. 524 TO 564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURE AND/OR TASKS:

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-E-1(TS)	SET UP MACHINE AND WORK PIECE
IX-E-1a(TS)	MILL DIMENSION "D"
IX-E-1b(TS)	SET UP AND MACHINE 1/2" WIDTH
IX-E-1c(TS)	SET UP AND MACHINE SERRATIONS
IX-A-1c(TS)	CLEAN UP MACHINE AND WORK STATION

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUPS.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, MATERIAL AND STANDARDS.
5. SAFE WORKING HABITS.

TASK SHEET

IX-E-1(TS)

TASK:	SET UP MACHINE AND WORK PIECE
JOB:	TOOL POST WEDGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	HORIZONTAL MILL, ARBOR, COLLARS, MILL VISE, SIDE MILLING CUTTER, PARALLEL BAR, LEAD HAMMER, SURFACE GAGE, DIAL INDICATOR, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP VISE	1. SET VISE JAWS PERPARALLEL TO ARBOR 2. INDICATE JAWS TRUE 3. WIPE INSIDE OF VISE CLEAN NOTE: CHECK TO SEE THAT VISE IS BOLTED
2. SET UP MACHINE	1. CHECK MACHINE FOR PROPER LUBRICATION 2. (REFER TO: IX-A-1(TS) FLAT HEAD SCREW)
3. SET UP CUTTER	1. SET UP ARBOR (REFER TO: IX-A-1a(TS) FLAT HEAD SCREW) 2. PLACE SIDE MILLING CUTTER ON ARBOR NOTE: BE SURE TEETH ARE POSITIONED IN CORRECT DIRECTION OF ARBOR ROTATION 3. TIGHTEN ARBOR NUT 4. TIGHTEN ARBOR SUPPORT ARM (REFER TO: IX-A-1a(TS) FLAT HEAD SCREW)
4. SET SPEED AND FEED	SEE CHART REF. #1, P. 38-16 OR REF. #2, PP. 549-550
5. SET UP WORK	1. WIPE VISE CLEAN 2. SET PARALLEL BAR IN VISE 3. SET RADII OF WORK PIECE ON PARALLEL BAR

NOTE: PARALLEL BAR MUST NOT BE AS THICK AS WORK PIECE, AND MUST BE WIDE ENOUGH TO PERMIT AREA TO BE CUT TO BE ABOVE TOP OF VISE

4. SNUG MILL VISE FIRMLY
5. LEVEL TOP OF WORK PIECE WITH SURFACE GAGE OR DIAL INDICATOR
6. TIGHTEN MILL VISE SECURELY AGAINST WORK PIECE

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

IX-E-1a(TS)

TASK: MACHINE DIMENSION "D"

TOOLS AND MATERIALS: MILL VISE, DEPTH MICROMETER, HORIZONTAL MILL, ARBOR, COLLARS, 6" RULE, MILL FILE, PARALLEL BARS, SIDE MILLING CUTTER.

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION WORK	1. PUT ON SAFETY GLASSES 2. POSITION ONE EDGE OF MILLING CUTTER SO AS TO COINCIDE WITH EITHER LAYOUT LINES 3. LOCK TRANSVERSAL TABLE LOCK 4. TURN MACHINE ON NOTE: CHECK CUTTER ROTATION AND THE CUTTER FOR CLEARANCE
2. CUT .060" RELIEF	1. RAISE TABLE BY HAND UNTIL CUTTER JUST TOUCHES THE STOCK (SEE JOB #1, FLAT HEAD SCREW) 2. RAISE TABLE .060" BY VERTICAL FEED DIAL 3. ENGAGE AUTOMATIC FEED 4. CUT WIDTH OF RELIEF AS LAID OUT NOTE: NUMBER OF CUTS WILL BE DETERMINED BY WIDTH OF CUTTER FACE 5. TURN MACHINE OFF 6. INSPECT FOR ACCURACY 7. REMOVE WORK PIECE
3. DEBURR	1. REMOVE MACHINE BURRS WITH FILE 2. BE CAUTIOUS IN HANDLING STOCK
4. CLEAN UP MACHINE	1. REMOVE ALL CHIPS USING CHIP BRUSH AND SHOP TOWEL 2. LUBRICATE WAYS 3. PLACE TOOLS IN PROPER PLACE
5. INSPECTION	HAVE INSTRUCTOR INSPECT FOR ACCURACY

SKETCHES: DRAWING #9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524 TO 564

TASK SHEET

IX-E-1b(TS)

TASK:	SET UP AND MACHINE 1/2" WIDTH
JOB:	TOOL POST WIDGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	HORIZONTAL MILL, ARBOR, COLLARS, MILL VISE, SIDE MILLING CUTTER, PARALLEL BAR, LEAD HAMMER, 6" RULE, MILL FILE, SURFACE GAGE, DIAL INDICATOR, WORKSTOCK

TASK BREAKDOWN

STEPS	KEY POINTS
1. CLEAN VISE	1. REMOVE PARALLELS FROM VISE
	2. CLEAN INSIDE OF VISE
2. SET UP WORK PIECE	1. PLACE WORK PIECE IN VISE WITH LAYOUT LINE ABOVE TOP OF VISE NOTE: USE PROPER PARALLEL BARS UNDER WORK PIECE
	2. INSPECT WORK FOR BEING LEVEL
	3. TIGHTEN MILL VISE SECURELY
3. SET UP CUTTER	1. SET UP ARBOR (SEE JOB #1, FLAT HEAD SCREW)
	2. PLACE MILLING GUTTER ON ARBOR NOTE: BE SURE OF PROPER DIRECTION OF TEETH ROTATION
	3. TIGHTEN ARBOR NUT
	4. TIGHTEN ARBOR SUPPORT
4. CUT WIDTH	1. CUT TO LAYOUT LINE
	2. SAME MANNER AS BEFORE NOTE: HOLD 1/2" WIDTH TO TOLERANCE
	3. STOP MACHINE
	4. INSPECT FOR SIZE
	5. REMOVE WORK PIECE
5. DEBURR	REMOVE MACHINE BURRS WITH FILE

6. INSPECTION	HAVE INSTRUCTOR INSPECT WORK PIECE FOR ACCURACY

SKETCHES: DRAWING #9 TOOL POST WEDGE

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

IX-E-1c(TS)

TASK: SET UP AND MACHINE SERRATIONS

JOB: TOOL POST WEDGE

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILL, ARBOR, COLLARS, MILL VISE, PARALLEL BARS, DIAL INDICATOR, 60° DOUBLE ANGLE, MILLING CUTTER, MILL FILE, LEAD HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN VISE	1. REMOVE PARALLEL BAR 2. WIPE INSIDE OF VISE
2. SET UP VISE	1. LOOSEN VISE LOCKING NUTS 2. SWIVEL VISE TO 45° 3. TIGHTEN VISE LOCKING NUTS 4. INSURE THAT VISE IS PROPERLY BOLTED TO TABLE
3. SET UP WORK PIECE	1. PLACE WORK PIECE IN VISE SO TOP OF WORK CLEARS THE TOP OF JAW NOTE: BE SURE THE JAW IS CLEAR FROM MAXIMUM DEPTH OF CUT 2. INSPECT WORK PIECE FOR BEING LEVEL 3. TIGHTEN MILL VISE FIRMLY AGAINST STOCK
4. SET FEED AND SPEED OF MACHINE	1. SEE CHART REF. #1, P. 38-16 OR REF. #2, PP. 549-550 2. SET DIRECTION OF FEED AND CUTTER ROTATION
5. CUT FIRST SERRATION	1. RAISE TABLE UNTIL CUTTER JUST TOUCHES WORK PIECE 2. POSITION CUTTER POINT DIRECTLY OVER ONE CORNER POINT OF STOCK 3. MOVE TABLE TRANSVERSALLY .125" NOTE: THIS IS THE DISTANCE BETWEEN SERRATIONS 4. MOVE TABLE LONGITUDINALLY TO CLEAR WORK PIECE

	5. RAISE TABLE VERTICALLY .060" NOTE: THIS IS THE DEPTH OF THE SERRATION 6. START MACHINE 7. CUT SERRATIONS IN ONE DIRECTION ACROSS THE WORK NOTE: MOVE TRANSVERSAL FEED .125 AFTER EACH CUT HAS BEEN MADE 8. CONTINUE UNTIL ALL SERRATIONS IN ONE DIRECTION HAVE BEEN CUT 9. STOP MACHINE
6. RESET FOR SECOND SERIES OF SERRATIONS TO BE CUT	1. LOOSEN VISE LOCKING NUT 2. SWIVEL VISE 90° NOTE: POSITION OF CUTTER SHOULD BE PERPENDICULAR TO PREVIOUS CUT 3. TIGHTEN VISE LOCKING NUTS
7. CUT SECOND SERRATION	1. CUT 2ND SERRATIONS THE SAME AS THE FIRST SERRATIONS 2. STOP MACHINE 3. REMOVE WORK PIECE
8. DEBURR	REMOVE MACHINE BURRS WITH FILE
9. INSPECT	CHECK ALL DIMENSIONS TO DRAWING SPECIFICATIONS
10. CLEAN MACHINE	1. BRUSH OFF MACHINE WITH CHIP BRUSH 2. WIPE MACHINE CLEAN WITH SHOP TOWEL 3. OIL WAYS OF MACHINE 4. RETURN TOOLS TO THEIR PROPER PLACE 5. DISPOSE OF WASTE MATERIALS

SKETCHES: DRAWING#9: TOOL POST WEDGE

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524 TO 564

MACHINE SHOP PARALLEL CLAMP

BENCH 5

DRILL PRESS 3

ENGINE LATHE 8

GRINDER 2

MILLING MACHINE 6

SHAPER 2

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A PARALLEL CLAMP ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES
2. SET UP AND PREPARE MACHINE FOR JOB
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS
5. HOLD ALL SURFACES TO PRECISION FINISH
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS
9. MAINTAIN SAFE WORKING HABITS

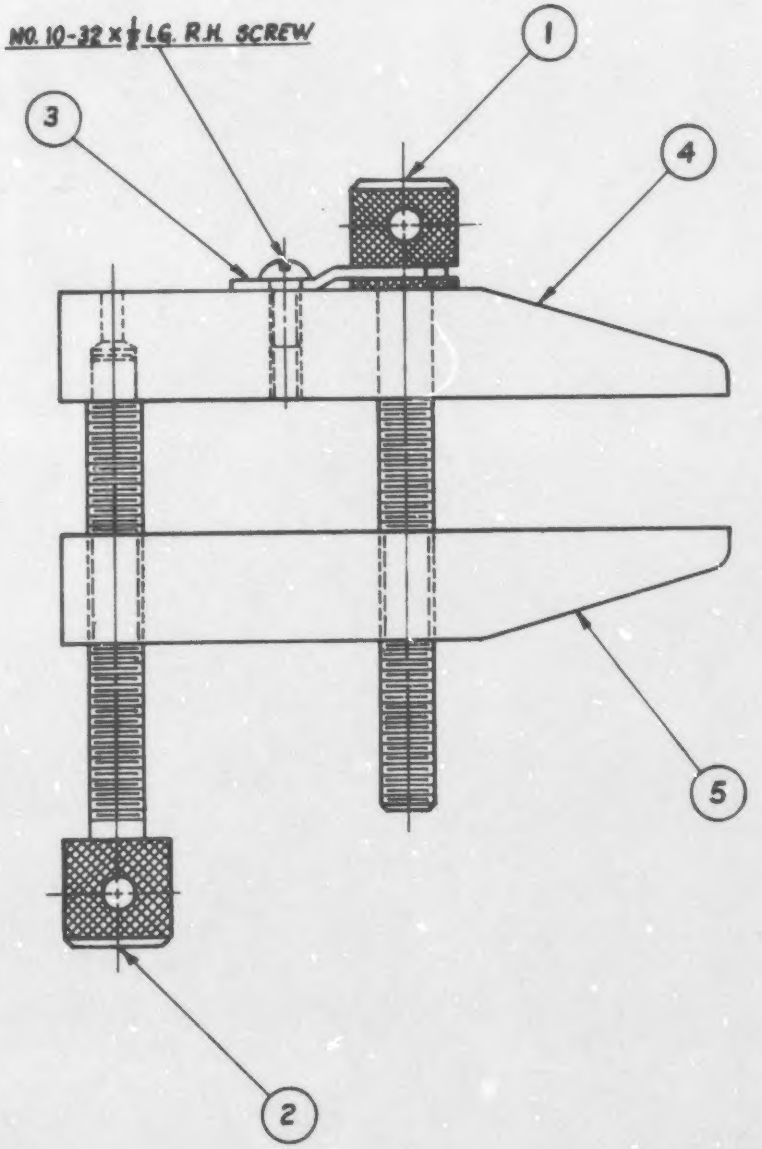
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

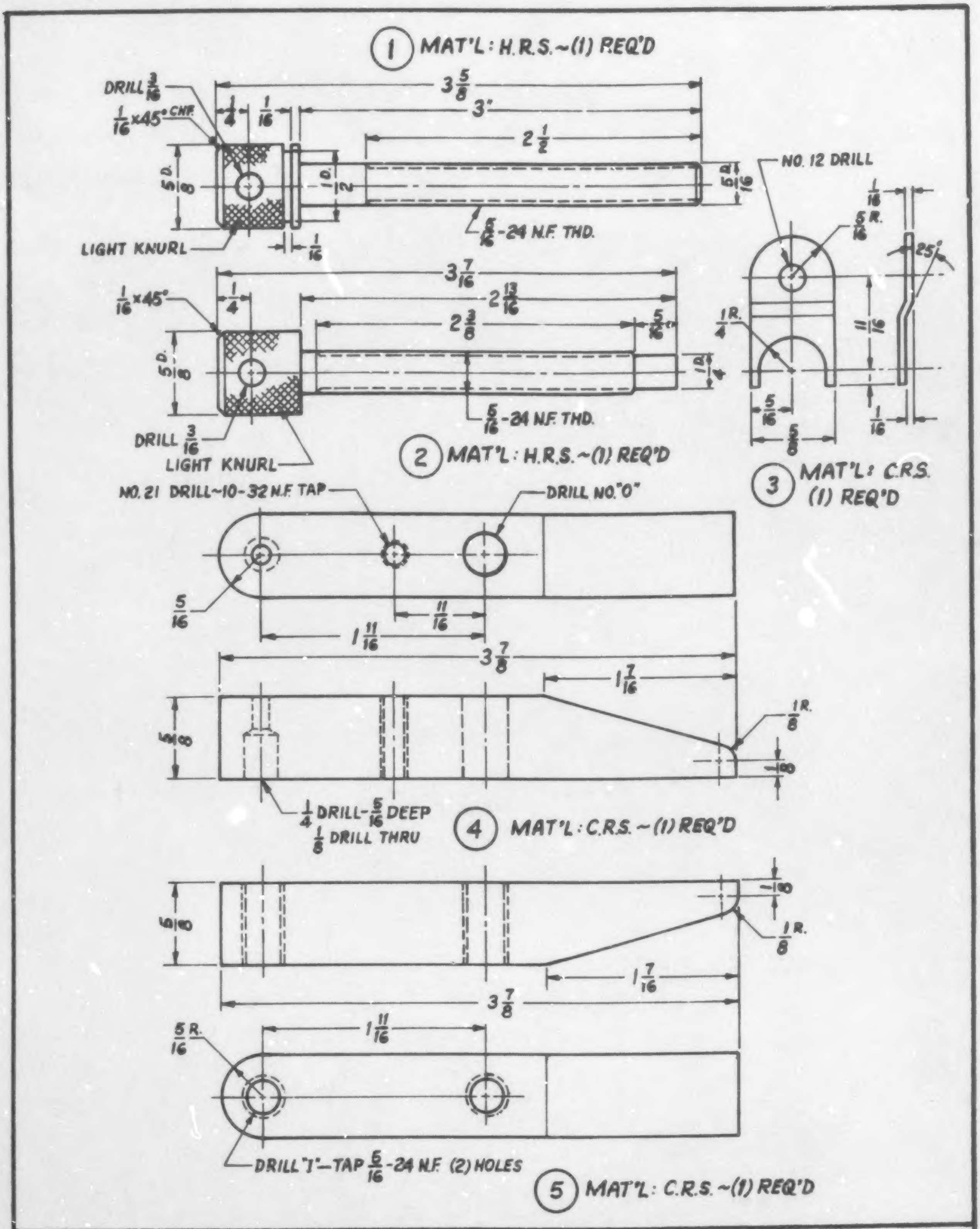
REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS

NOTE: IN THIS JOB STUDENT WILL GET ALL NECESSARY MATERIALS FROM SUPPLY PRIOR TO STARTING THE TASK FOR CONSTRUCTION OF THIS MULTI-PART JOB. THE STUDENT IS CHARGED WITH KEEPING TRACK OF EACH AND ALL PARTS. JOB AND TASK SHEETS ARE WRITTEN FOR THE COMPLETION OF EACH PART BEFORE PROCEEDING TO THE NEXT PART. UPON COMPLETION OF A PART, THE STUDENT WILL HOLD THAT PART FOR ASSEMBLY AND PROCEED TO THE NEXT PART



DRAWING NO. 10	PARALLEL CLAMP	TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 5 SHAPER JOB NO. 2 LATHE JOB NO. 8 DRILL PRESS JOB NO. 3	MATERIAL: (SEE DETAILS, SHT. 10A) FINISH: (SEE DETAILS, SHT. 10 A) SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°



① MAT'L: H.R.S.~(1) REQ'D
DRILL 3/16
1/16 × 45° CHF.
3 5/8
3"
2 1/2
1/4
1/16
5/8 D.
1/2 D.
5/16 D.
5/16-24 N.F. THD.
LIGHT KNURL
3 7/16
2 13/16
2 3/8
5/16
1/4 D.
1/16 × 45°
DRILL 3/16
② MAT'L: H.R.S.~(1) REQ'D
NO. 12 DRILL
5/16 R.
1/4 R.
11/16
25°
5/8
③ MAT'L: C.R.S. (1) REQ'D
NO. 21 DRILL~10-32 N.F. TAP
DRILL NO. "O"
11/16
1 11/16
3 7/8
1 7/16
1/8 R.
1/8
1/4 DRILL-5/16 DEEP
1/8 DRILL THRU
④ MAT'L: C.R.S.~(1) REQ'D
5/16 R.
DRILL "I"–TAP 5/16-24 N.F. (2) HOLES
⑤ MAT'L: C.R.S.~(1) REQ'D

DRAWING NO. 10A	PARALLEL CLAMP DETAILS	TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 5 SHAPER JOB NO. 2 DRILL PRESS JOB NO. 3 MILLING MACHINE JOB NO. 6 LATHE JOB NO. 8	MATERIAL: SEE DETAILS FINISH: CASE HD'N .020 DP. SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-I-1(J)

JOB SHEET
ON
ENGINE LATHE

JOB: PARALLEL CLAMP

MATERIALS: 5/8" X 7 1/4" COLD ROLL STEEL
NOTE: THIS WILL MAKE BOTH PARTS #1 AND #2

TOOLS AND EQUIPMENT: ENGINE LATHE, UNIVERSAL CHUCK, FACE PLATE, TAILSTOCK DRILL CHUCK AND KEY, #1 CENTER DRILL, FACING TOOL, TURNING TOOL, 60° THREADING TOOL, DEAD CENTER, LIVE CENTER, 1/16" GROOVING TOOL, CENTER GAGE, LATHE DOG, LAYOUT INK, 6" RULE, PRICK PUNCH, CENTER PUNCH, BALL PEEN HAMMER, VERNIER CALIPER, THREE CORNER FILE, SHIM STOCK, POWER HACKSAW, ALUMINUM BLOCK, FOUR JAW CHUCK, V-BLOCK AND CLAMP, DRILL PRESS, LAYOUT BENCH, 3/16" DRILL

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LAYOUT, PP. 6-1 TO 6-10; LATHES, PP. 36-1 TO 36-44; DRILL PRESS, PP. 34-3 TO 34-14; REF. #2, LAYOUT, PP. 62-72; LATHES, PP. 462-494; DRILL PRESS, PP. 194, 209, 213-217 CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-C-1(TS)	SET UP, FACE AND CENTER DRILL WORKPIECE
VII-C-1a(TS)	SET UP AND KNURL WORKPIECE
VII-B-1d(TS)	SET UP AND TURN 5/16" DIAMETER BOTH ENDS
VII-F-1b(TS)	SET UP AND TURN 1/16" GROOVE ON PART #1
VII-B-1d(TS)	SET UP AND TURN 1/4" DIAMETER ON PART #2
VII-I-1(TS)	SET UP AND THREAD 5/16" - 24 NF BOTH ENDS

ROUTE TO POWER HACKSAW

VII-I-1a(TS)	FACE AND CHAMFER SCREW HEADS NOTE: HOLD 3 5/8" AND 3 7/16" LENGTHS ACCORDING TO SPECIFICATIONS

ROUTE CLAMP SCREWS TO BENCH

IV-B-1(TS)	LAY OUT AND LOCATE CENTER FOR 3/16" DRILL - BOTH CLAMP SCREW HEADS

ROUTE TO DRILL PRESS

VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VI-B-1(TS)	SET UP AND DRILL 3/16" HOLES IN PART #1 AND PART #2

BURR AND HOLD PARTS FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR MACHINE TOOLS, EQUIPMENT, SUPPLIES AND STANDARDS
5. SAFE WORKING HABITS

TASK SHEET

TASK: SET UP AND THREAD 5/16"-24

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACEPLATE, DOG, DEAD CENTER, LIVE CENTER, THREADING TOOL, CENTER GAUGE, 6" RULE, THREE CORNERED FILE, LAYOUT TOOLS, SHIM STOCK

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP COMPOUND REST	1. LEAVE WORK PIECE SET UP BETWEEN CENTERS. NOTE: 5/16" X 3" IS AT HEAD STOCK. BOTH ENDS TO BE THREADED 2. SET UP THREADING TOOL IN TOOL HOLDER 3. PLACE TOOL HOLDER IN COMPOUND REST, LEAVE LOOSE 4. SET COMPOUND REST ON 29° TO THE RIGHT AND TIGHTEN
2. SET UP TOOL	1. SET THREADING TOOL SQUARE TO WORK. USE CENTER GAUGE. SEE REF. #1, PP. 36-30, 31 OR REF. #2, P. 489 2. SET TOOL ON CENTERLINE OF WORKPIECE
3. SET QUICK CHANGE LEVERS	1. SET UP QUICK CHANGE LEVERS TO CUT TWENTY-FOUR THREADS PER INCH
4. SET FEED CHANGE LEVER	1. SET FEED CHANGE LEVER TO THREADING POSITION
5. THREAD FIRST END	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON 3. TURN CROSS SLIDE HANDLE UNTIL POINT OF TOOL TOUCHES WORK PIECE 4. SET CROSS FEED DIAL TO "O" 5. MOVE CARRIAGE TO RIGHT UNTIL TOOL IS OFF WORKPIECE 6. ENGAGE THREAD DIAL AND TIGHTEN 7. TURN CROSS SLIDE HANDWHEEL TO ADVANCE TOOL IN .005"

	8. ENGAGE HALF-NUT LEVER NOTE: ANY NUMBER LINE ON DIAL MUST BE IN LINE WITH INDEX LINE ON OUTER RING. 9. WHEN TOOL IS 1/4" AWAY FROM SHOULDER, DISENGAGE HALF-NUT LEVER, AND AT THE SAME TIME TURN CROSS SLIDE HANDWHEEL COUNTERCLOCKWISE ONE COMPLETE TURN TO BRING TOOL AWAY FROM WORKPIECE 10. TURN CARRIAGE HANDWHEEL TO BRING POINT OF TOOL BACK TO RIGHT END OF AREA BEING THREADED. THIS IS THE STARTING POSITION 11. TURN CROSS SLIDE HANDWHEEL CLOCKWISE ONE COMPLETE TURN, TO "O" PLUS .005" NOTE: THIS IS WHERE LAST CUT WAS MADE 12. REPEAT SAME PROCEDURE REMOVING ANOTHER .005" NOTE: IT WILL BE NECESSARY TO REDUCE DEPTH OF FUTURE CUTS TO .003" THEN .002". THE LAST FEW CUTS SHOULD BE MADE REMOVING ONLY .001" PER CUT 13 CONTINUE CUTTING TO DESIRED DEPTH AND PROPER THREAD IS OBTAINED
6. THREAD SECOND END	1. TURN WORKPIECE AROUND 2. PROTECT THREADS FROM BEING DAMAGED BY DOG NOTE: USE SHIM STOCK BETWEEN THREADS AND DOG 3. THREAD SECOND END IN SAME MANNER AS THE FIRST
7. TURN 1/16" X 45° CHAMFER ON THREAD END	1. SET COMPOUND REST AT 45° ANGLE 2. PLACE TURNING TOOL IN TOOL HOLDER 3. SET MACHINE SPEED 4. HAND FEED COMPOUND REST TO OBTAIN 1/16" CHAMFER
8. CUT WORKPIECE INTO TWO PARTS, #1 AND #2	1. LAY OUT CUT OFF LINE NOTE: BE SURE GROOVED END IS OVER 3 5/8" FROM END AND OPPOSITE END IS OVER 3 7/16" FROM END.

2. SEVER WORK. REFER TO: V-A-1(TS)
   CAUTION: DO NOT USE PARTING TOOL BETWEEN CENTERS. ROUTE WORKPIECE TO SAW
3. PROTECT BOTH SIDES CF WORKPIECE WITH ALUMINUM TO PROTECT THREADS
4. SAW WORKPIECE INTO TWO PARTS
5. ROUTE TO ENGINE LATHE TO FACE AND CHAMFER SCREW HEADS

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 36-28 TO 36-33 AND PP. 35-1 TO 35-4
REF. #2, PP. 488-491 AND PP. 90-100

TASK SHEET VII-I-1a(TS)

TASK: FACE AND CHAMFER SCREW HEADS

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND EQUIPMENT: ENGINE LATHE, 4-JAW CHUCK, 6" RULE, TURNING TOOL, DIAL INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE	1. CHUCK IN 4-JAW CHUCK NOTE: PROTECT THREADS WITH BRASS SHIM STOCK NOTE: CHECK THAT WORK PIECE IS TRUE
2. SET UP MACHINE	1. SET FEED AND SPEED REFER TO CHART: REFERENCE #3, P. 152; REF. #1, P. 36-14
3. SET TOOLING	1. SET COMPOUND REST AT 45° 2. POSITION TOOL ON CENTER
4. FACE AND CHAMFER HEAD	1. FACE HEAD TO HOLD REQUIRED LENGTH NOTE: HOLD 3 5/8" AND 3 7/16" RESPECTIVELY 2. CUT 1/16" CHAMFER AT 45° ANGLE WITH COMPOUND REST ROUTE TO BENCH

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, P. 36-25
REF. #2, PP. 445-446

VI-B-I(J)

JOB SHEET
ON
DRILL PRESS

JOB:	PARALLEL CLAMP	
MATERIALS:	CLAMP SCREWS, PART #1 AND PART #2 AS MACHINED ON ENGINE LATHE	
TOOLS AND EQUIPMENT:	DRILL PRESS, DRILL VISE, CUTTING OIL, 3/16" DRILL BIT, SMALL ROUND FILE, V-BLOCKS AND CLAMP	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, DRILL PRESS, PP. 34-3 TO 34-14 AND REF. #2, DRILL PRESS, PP. 194, 209, 213-219	
PROCEDURE AND/OR TASKS:	VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	VI-B-1(TS)	SET UP AND DRILL HOLES IN CLAMP SCREWS PART #1 AND PART #2
	BURR AND HOLD PARTS FOR ASSEMBLY	
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS. 1. CHECK MACHINE FOR PROPER OPERATING CONDITION. 2. CHECK MACHINE FOR PROPER SETUP. 3. ALL DIMENSIONS HELD TO SPECIFICATIONS. 4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR MACHINE TOOLS, EQUIPMENT, SUPPLIES, AND STANDARDS. 5. SAFE WORKING HABITS.	

TASK SHEET VI-B-1(TS)

TASK: SET UP AND DRILL HOLES IN CLAMP SCREWS, PART #1 AND PART #2

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL VISE, CUTTING OIL, 3/16" DRILL BIT, SMALL ROUND FILE, V-BLOCKS AND CLAMP

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK MACHINE FOR PROPER WORKING CONDITION	REFER TO PREVIOUS TASK, "SET UP AND DRILL HOLES IN CLAMP JAWS,"VI-A-1(TS)
2. SET UP MACHINE AND WORK PIECE	REFER TO PREVIOUS TASK, "SET UP AND DRILL HOLES IN CLAMP JAWS," VI-A-1a (TS)
3. CLAMP SCREWS IN V-BLOCKS	1. PLACE SCREW IN V-BLOCKS WITH HEAD EXTENDING OVER EDGE NOTE: EXTEND ONLY ENOUGH TO CLEAR DRILL 2. TIGHTEN V-BLOCK CLAMP SCREW ONTO SCREW NOTE: USE SHIM STOCK TO PROTECT THREADS
4. LOCATE CENTER AND DRILL 3/16" HOLE	1. POSITION CENTER PUNCHED HOLE IN ALIGNMENT WITH POINT OF DRILL BIT 2. DRILL 3/16" HOLE THOUGH WORKPIECE CAUTION: FEED DRILL CAREFULLY TO AVOID DRILL WALKING OR BREAKING
5. REMOVE WORKPIECE	1. REMOVE WORKPIECE FROM VISE 2. CLEAN VISE 3. REMOVE BURRS
6. DRILL SECOND CLAMP SCREW	1. REPEAT SAME STEPS AS FOR FIRST CLAMP SCREW 2. HOLD FOR ASSEMBLY

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 34-3 TO 34-14
REF. #2, PP. 194, 209, 213-217

JOB SHEET
ON
ENGINE LATHE

JOB: PARALLEL CLAMP

MATERIALS: PIN - 3/16"^{D} X 2" COLD ROLLED STEEL - 2 PIECES

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 3/16" COLLET, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, PP. 36-1 TO 36-44; REF. #2, LATHES, PP. 462-494

PROCEDURES AND/OR TASKS: OBTAIN SPECIFIED MATERIALS FROM SUPPLY

	ROUTE TO ENGINE LATHE
VII-A-1(TS)	CHECK LATHE FOR PROPER OPERATING CONDITION
VII-A-1a(TS)	SET UP COLLET ATTACHMENT AND 3/16" COLLET
VII-I-2(TS)	FILE SPHERICAL RADIUS ON BOTH ENDS OF PIN
	INSPECT AND HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-I-2(TS)

TASK: FILE SPHERICAL RADIUS ON BOTH ENDS OF PIN

JOB: C-CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 3/16" COLLET, MILL FILE, 3/32" RADIUS GAGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK WORKPIECE	1. WORKPIECE TO BE TIGHTENED FIRMLY 2. WORKPIECE TO PROTRUDE 1/2" FROM COLLET CAUTION: PROTRUDING TOO FAR COULD RESULT IN BENDING OF WORKPIECE WHILE FILING
2. SET MACHINE	1. SET SPINDLE SPEED APPROXIMATELY 300 RPM 2. DISENGAGE LEAD SCREW AND FEED ROD
3. FILE SPHERICAL RADIUS ON FIRST END	1. PLACE FILE ON TOP EDGE OF WORKPIECE 2. ROLL FILE OFF TO THE RIGHT AND DOWNWARD, AS STROKING FILE FORWARD CAUTION: TAKE ALL PRECAUTIONS FOR SAFETY IN FILING ON THE LATHE 3. CHECK RADIUS WITH 3/16" RADIUS GAGE 4. REVERSE ENDS
4. FILE SPHERICAL RADIUS ON SECOND END	1. REPEAT THE SAME PROCEDURE USED IN FILING FIRST END. REMOVE FROM COLLET
5. SECOND PIN	1. FOLLOW SAME PROCEDURE AS FOR THE FIRST.
6. CLEAN MACHINE	REFER TO: VIIA-1c(TS) HOLD FOR ASSEMBLY

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 36-37 TO 36-38
REF. #2, PP. 193 TO 194

X-G-1(J)

JOB SHEET
ON
GRINDER

JOB: PARALLEL CLAMP

MATERIALS: CLAMP JAWS, PART #4 AND #5, TWO PIECES
5/8" X 5/8" X 3 15/16" COLD ROLL STEEL

TOOLS AND EQUIPMENT: OPTIONAL GRINDER (BELT SANDER, DISC GRINDER, OR TOOL GRINDER) 6" RULE, COMBINATION SQUARE, LAYOUT INK, SCRIBER, 5/16" RADIUS GAGE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LAYOUT, PP. 6-1 TO 6-10; REF. #1, GRINDING, PP. 33-1 TO 33-14; REF. #2, LAYOUT, PP. 62-72

PROCEDURE AND/OR TASKS:

X-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
X-G-1(TS)	GRIND CLAMP JAW ENDS TO FINISH SIZE
X-G-1a(TS)	GRIND SPECIFIED RADII ON ENDS OF CLAMP JAWS
	ROUTE TO BENCH

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS.
4. SAFE WORKING HABITS.

TASK SHEET

X-G-1(TS)

TASK: GRIND ENDS OF CLAMP JAW TO FINISH LENGTH

TOOLS AND MATERIALS: PROTRACTOR GUIDE, BELT SANDER, DISC SANDER, TOOL GRINDER, OR PEDESTAL GRINDER. NOTE: THE TOOL GRINDER WILL BE USED IN THIS TASK

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK MACHINE FOR PROPER OPERATING CONDITION	1. INSPECT MACHINE FOR PROPER GRINDING WHEEL 2. INSPECT WHEEL FOR SAFETY 3. CHECK SAFETY SHIELD IF ATTACHED 4. CHECK GRINDING WHEEL FOR TRUENESS
2. CHECK MACHINE SETUP	1. CHECK TOOL FOR SQUARENESS 2. CHECK SPACE BETWEEN GRINDING WHEEL AND TOOL REST CAUTION: KEEP SPACE 1/16" MAXIMUM
3. GRIND 1ST END	1. SET PROTRACTOR GUIDE ON 0° NOTE: THE WORKPIECE WOULD BE PERPENDICULAR TO GRINDING WHEEL 2. CUT ON COOLANT (IF TOOL GRINDER IS WET TYPE) 3. POSITION WORKPIECE AGAINST PROTRACTOR GUIDE FENCE 4. SLIDE WORKPIECE UNTIL IT JUST TOUCHES GRINDING WHEEL 5. APPLY A FIRM PRESSURE AGAINST WHEEL AS THE WORKPIECE IS MOVED BACK AND FORTH ACROSS WHEEL CAUTION: IF DRY GRINDING, QUENCH WORKPIECE FREQUENTLY TO AVOID OVERHEATING 6. GRIND TILL SAW MARKS ARE REMOVED
4. INSPECT	1. CHECK FOR SQUARENESS WITH SQUARE 2. CHECK TO INSURE REMOVAL OF ALL SAW MARKS

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 121-126

TASK SHEET X-G-1a(TS)

TASK: GRIND SPECIFIED RADII ON ENDS OF CLAMP JAWS

TOOLS AND MATERIALS: CLAMP JAWS, PARTS #4 AND #5
NOTE: ALL OTHER TASKS ARE COMPLETE AT THIS POINT.
TOOL GRINDER, MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK MACHINE FOR PROPER OPERATING CONDITION	REFER TO: JOB #10 PARALLEL CLAMP, VIII-B-1(TS)
2. CHECK MACHINE SETUP	REFER TO: JOB #10 PARALLEL CLAMP, VIII-B-1(TS)
3. GRIND 1/8"^{R}	1. REMOVE PROTRACTOR GUIDE 2. CUT ON COOLANT, (IF WET TYPE) 3. SLIDE WORKPIECE AGAINST WHEEL 4. ROTATE WORKPIECE FOLLOWING LAYOUT ARC 5. GRIND TILL LAYOUT LINE IS REACHED 6. INSPECTION WITH RADIUS GAGE 7. BURR EDGES
4. GRIND 5/16"^{R}	1. USE THE SAME PROCEDURE AS IN STEP #3. GRINDING 1/8"^{R}
5. SECURE MACHINE	1. CUT OFF GRINDER 2. CUT OFF COOLANT 3. WIPE MACHINE TO REMOVE COOLANT AND SHAVINGS ROUTE TO BENCH

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 33-1 TO 33-14.
REF. #2, PP. 121 TO 126.

IV-D-1(J)

JOB SHEET
ON
BENCH

JOB:	PARALLEL CLAMP	
MATERIALS:	CLAMP JAWS, PARTS #4 AND #5 AS MACHINED ON TOOL GRINDER	
TOOLS AND EQUIPMENT:	BENCH, BENCH VISE, LAYOUT INK, COMBINATION SQUARE, SCRIBE, CENTER PUNCH, BALL PEEN HAMMER, DIVIDER, 6" RULE, TAP WRENCH, #10-32 NF TAPER TAP, 5/16"-24 NF TAPER TAP, #10-32 NF BOTTOM TAP, 5/16"-24 NF BOTTOM TAP, SMALL ROUND FILE, CUTTING OIL	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, LAYOUT, PP. 6-1 TO 6-10; THREADING, PP. 11-1 TO 11-5; REF. #2, LAYOUT, PP. 62-72 AND THREADING, PP. 241-246	
PROCEDURE AND/OR TASK:	IV-D-1(TS)	LAY OUT PARALLEL CLAMP JAWS AND CENTERS FOR HOLES ROUTE TO DRILL PRESS
	VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	VI-A-1a(TS)	SET UP AND DRILL HOLES IN CLAMP JAWS ROUTE TO BENCH
	IV-D-1a(TS)	SET UP AND TAP HOLES IN CLAMP JAWS ROUTE TO SHAPER OR MILLING MACHINE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS.	

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR MACHINE TOOLS, EQUIPMENT, SUPPLIES, AND STANDARDS.
5. SAFE WORKING HABITS.

TASK SHEET

IV-D-1(TS)

TASK: LAYOUT PARALLEL CLAMP JAWS AND CENTERS FOR HOLES

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: LAYOUT BENCH, LAYOUT DYE, COMBINATION SQUARE, SCRIBE, CENTER PUNCH, BALL PEEN HAMMER, DIVIDER, 6" RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAY OUT CENTER LINE OF WORKPIECE	1. INK WORKPIECE 2. SET COMBINATION SQUARE ON 5/16" 3. LAY OUT CENTER LINE OF WORK PIECE WITH SCRIBE
2. LAY OUT CENTER LINE OF HOLES	1. SET COMBINATION SQUARE ON 5/16" 2. LAY OUT CENTER LINE OF 1/4" HOLE ON PART #4 AND "I" HOLE ON PART #5 NOTE: THIS WILL ALSO BE THE CENTER FOR 5/16" RADIUS 3. SET COMBINATION SQUARE ON 1 5/16" 4. LAY OUT CENTER LINE OF #21 DRILL HOLE ON PART #4 5. SET COMBINATION SQUARE ON 2" 6. LAY OUT CENTER LINES OF #"O" DRILLED HOLE ON PART #4 AND "I" DRILLED HOLE ON PART #5 7. LIGHTLY CENTER PUNCH ALL CENTERS
3. LAY OUT ANGLE ON PARTS #4 AND #5	1. SET COMBINATION SQUARE ON 2 7/16" 2. LAY OUT TOP ON ANGLE FROM REFERENCE END 3. SET COMBINATION SQUARE ON 1/4" 4. LAY OUT SMALL END OF ANGLE 5. SCRIBE LINE FROM TOP TO END OF ANGLE
4. LAY OUT 1/8" RADIUS	1. SET COMBINATION SQUARE ON 1/8" 2. LAY OUT CENTER OF 1/8" RADIUS 3. CENTER PUNCH LIGHTLY 4. SET DIVIDER FOR 1/8" 5. SCRIBER 1/8" RADIUS NOTE: ANGLE SHOULD BE TANGENT TO ARC RADIUS

5. LAY OUT RADIUS END	1. SET DIVIDER ON 5/16" 2. PLACE ON LEG OF DIVIDER IN CENTER PUNCH OF 1/4" HOLE. REFER TO STEP #2 3. SCRIBE 5/16" ARC RADIUS AROUND END OF WORKPIECE ROUTE TO DRILL PRESS

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62 TO 72

TASK SHEET

IV-D-1a(TS)

TASK: SET UP AND TAP HOLES IN CLAMP JAWS

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH, BENCH VISE, CUTTING OIL, TAP WRENCH, #10-32 N. F. TAPER TAP, 5/16-24 N. F. TAPER TAP, SMALL ROUND FILE, #10-32 N. F. BOTTOM TAP, 5/16-24 N. F. BOTTOM TAP

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLAMP WORKPIECE	1. OPEN BENCH VISE 2. POSITION WORKPIECE IN VISE CAUTION: USE VISE JAW CAPS IF JAWS ARE SERRATED 3. TIGHTEN VISE JAWS FIRMLY
2. LOCATE AND START #10-32 N. F. TAP	1. POSITION TAP IN TAP HOLDER NOTE: SIZE AND TYPE TAP WILL BE DETERMINED BY SPECIFICATIONS 2. POSITION TAP INTO TAP DRILL HOLE NOTE: TAP MUST BE PERPENDICULAR TO WORKPIECE
3. TAP HOLE	1. TURN TAP CLOCKWISE APPLYING FIRM PRESSURE 2. REVERSE DIRECTION AFTER EVERY REVOLUTION TO BREAK CHIPS LOOSE NOTE: ADD CUTTING OIL FREELY 3. TAP HOLE TO SPECIFIED DEPTH 4. BACK TAP OUT AND RECHASE THREADS 5. CLEAN CHIPS OUT AND BURR HOLE WITH ROUND FILE
4. TAP HOLES FOR 5/16"-24 N. F. THREAD	1. FOLLOW SAME PROCEDURE AS FOR #10-32 N. F. THREAD ROUTE TO SHAPER OR MILLING MACHINE

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 11-1 TO 11-5
REF. #2, PP. 241-246
REF. #3, PP. 84-89

JOB SHEET
ON
SHAPER

VIII-B-1(J)

JOB:	PARALLEL CLAMP
MATERIALS:	CLAMP JAWS-PARTS #4 AND #5-TWO PIECES 5/8" X 5/8" X 3 15/16" COLD ROLL STEEL
TOOLS AND EQUIPMENT:	SHAPER, SHAPER VISE, SURFACE GAGE, SOFT FACE HAMMER, CUTTING TOOL, MILL FILE, ALTERNATE: HORIZONTAL MILL, MILL VISE, PLAIN MILLING CUTTER, COLLARS, ARBOR
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, SHAPER, PP. 37-1 TO 37-16; REF. #2, SHAPER, PP. 499-523. ALTERNATE: REF. #1, MILLING MACHINE, PP. 38-1 TO 38-36; REF. #2, PP. 459-460

PROCEDURE AND/OR TASK:	VIII-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	VIII-A-1a(TS)	SET UP MACHINE AND VISE
	VIII-B-1(TS)	SET UP WORKPIECE AND MACHINE ANGLE
ALTERNATE:	HORIZONTAL MILLING MACHINE	
	IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	IX-E-1(TS)	SET UP MACHINE AND WORKPIECE
	IX-F-1(TS)	SET UP WORKPIECE AND MACHINE ANGLES

HOLD FOR ASSEMBLY

CHECK POINT: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, ANDSTANDARDS.
4. SAFE WORKING HABITS.

TASK SHEET

VIII-B-1(TS)

TASK: SET UP WORKPIECE AND MACHINE ANGLES

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, SURFACE GAGE, SOFT FACE HAMMER, CUTTING TOOL WITH 1/16" RADIUS, 6" RULE, MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK MACHINE FOR PROPER OPERATING CONDITION	REFER TO: VIII-A-1(TS)
2. SET UP MACHINE AND VISE	REFER TO: VII-A-1a(TS)
3. SET UP WORKPIECE	1. WIPE VISE CLEAN 2. PLACE WORKPIECE IN VISE WITH ANGLE LINE PARALLEL TO TOP OF VISE AND ABOVE VISE JAWS NOTE: BOTH PIECES MAY BE MACHINED TOGETHER IF THEY ARE SET UP PROPERLY. CHECK WITH INSTRUCTOR 3. SNUG VISE ON WORKPIECE 4. SET SURFACE GAGE WITH SCRIBE ON TOP OF VISE 5. TRUE WORK BY TAPPING WORKPIECE UNTIL SCRIBED LINE IS PARALLEL TO VISE TOP. NOTE: CHECK WITH SURFACE GAGE SCRIBE 6. TIGHTEN VISE
4. MACHINE ANGLE	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. MACHINE TO LAYOUT LINE NOTE: REMOVE ABOUT .050" PER CUT. SLOW FEED ON LAST CUT TO INSURE SMOOTH FINISH 4. CUT SECOND PART SAME AS FIRST UNLESS MACHINED TOGETHER 5. REMOVE FROM VISE 6. REMOVE MACHINE BURRS WITH FILE 7. CLEAN MACHINE HOLD FOR ASSEMBLY

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

IX-F-1(J)

JOB SHEET
ON
HORIZONTAL MILLING MACHINE

JOB: PARALLEL CLAMP

MATERIALS: CLAMP JAWS-PARTS #4 AND #5-TWO PIECES 5/8" X 5/8" X 3 15/16" COLD ROLL STEEL

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, 6" RULE, SOFT FACED HAMMER, PLAIN MILLING CUTTER, SPACING COLLARS, SURFACE GAGE, CUTTING OIL, CHIP BRUSH, WIPING RAG, MILL VISE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1 MILLING MACHINE, PP. 38-1 TO 38-36; REF. #2 PP. 459-460

PROCEDURE AND/OR TASK:

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-E-1(TS)	SET UP MACHINE AND WORKPIECE
IX-F-1(TS)	SET UP WORKPIECE AND MACHINE ANGLES HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS.
4. SAFE WORKING HABITS.

ALTERNATE TASK SHEET

IX-F-1(TS)

TASK: SET UP WORKPIECE AND MACHINE ANGLES

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, 6" RULE, SOFT FACED HAMMER, PLAIN MILLING CUTTER, COLLARS, CUTTING OIL, SURFACE GAGE, CHIP BRUSH, WIPING RAG, MILL VISE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK MACHINE FOR PROPER OPERATING CONDITION	REFER TO: II-A-1(TS)
2. SET UP MACHINE AND VISE	REFER TO: II-E-1a(TS)
3. SET FEED AND SPEED	1. SEE CHART REF. #1, P. 38-16 OR REF. #2, PP. 549-550 2. SET ROTATION OF CUTTER AND FEED
4. SET UP WORKPIECE AND MACHINE ANGLES	1. WIPE VISE CLEAN 2. PLACE WORKPIECE IN VISE WITH ANGLE LINE (LAYOUT LINE) PARALLEL TO TOP OF VISE AND ABOVE JAWS NOTE: BOTH PIECES MAY BE MACHINED TOGETHER IF SET UP PROPERLY. CHECK WITH INSTRUCTOR 3. SNUG WORKPIECE IN VISE 4. SET SURFACE GAGE WITH SCRIBE ON TOP OF VISE 5. TRUE WORK BY TAPPING WORKPIECE UNTIL SCRIBED LINE IS PARALLEL TO VISE TOP NOTE: CHECK WITH SURFACE GAGE SCRIBE 6. TIGHTEN VISE
5. MACHINE ANGLES	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. MACHINE TO LAYOUT LINE NOTE: REMOVE ABOUT .060" PER CUT. SLOW FEED ON LAST CUT TO INSURE SMOOTH FINISH

4. CUT SECOND PART SAME AS FIRST UNLESS MACHINED TOGETHER
5. REMOVE WORKPIECE
6. REMOVE MACHINE BURRS WITH FILE
7. CLEAN MACHINE
   HOLD FOR ASSEMBLY

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 38-1 TO 38-36
REF. #2, PP. 459-460

IV-E-1(J)

JOB SHEET
ON
BENCH

JOB: PARALLEL CLAMP

MATERIALS: CLIP-1 PIECE-1/16" X 5/8" X 1 1/8" COLD ROLLED STEEL PARTS #1 AND #2-CLAMP SCREWS; PARTS #4 AND #5-CLAMP JAWS; PART #3-SCREW RETAINING CLIP; #10-32 X 1/2" RH SCREW (STOCK ITEM)

TOOLS AND EQUIPMENT: LAYOUT INK, SCRIBE, 6" RULE, COMBINATION SQUARE, DIVIDER, BENCH VISE, PROTRACTOR, MILL FILE, BALL PEEN HAMMER, 1/16" FLAT BAR (FOR BENDING PURPOSE)

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LAYOUT, PP. 6-8 TO 6-9; DRILLING, PP. 34-3 TO 34-14; GRINDING, PP. 33-1 TO 33-14; SHEET METAL, PP. 19-9 TO 19-13; REF. #2, LAYOUT, PP. 62-72; DRILLING, PP. 194, 209, 213-219; BENDING SHEET METAL, PP. 296-298

PROCEDURES AND/OR TASKS:

	OBTAIN MATERIAL FROM SUPPLY
IV-D-1(TS)	LAY OUT CENTER LINES AND BEND LINES ON WORKPIECE
VI-C-1(TS)	DRILL SPECIFIED HOLES NOTE: 1/2" DRILL WILL FORM THE COMPLETED RADIUS FOR 1/4" RADIUS
X-G-1a(TS)	GRIND 5/16"^{R} ON END
IV-E-1(TS)	MAKE 25° OFFSET BEND
IV-E-1a(TS)	ASSEMBLE PARTS OF CLAMP

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS.
4. SAFE WORKING HABITS.

TASK SHEET IV-E-1(TS)

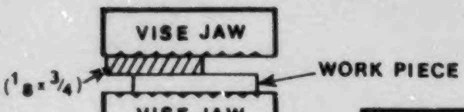
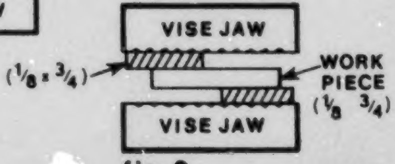
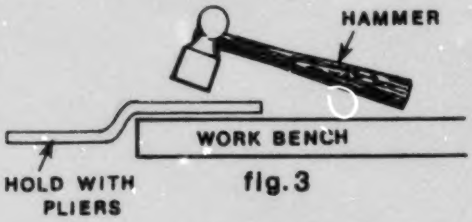
TASK: MAKE 25° OFFSET BEND IN SCREW CLIP

JOB: PARALLEL CLAMP

TRADE: MACHINIST

TOOLS AND EQUIPMENT: BENCH VISE, BALL PEEN HAMMER, 2 PCS. OF 1/8" X 3/4" X 3/4" STRAP

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION MATERIAL IN VISE  fig.1  VISE JAW (1/8 x 3/4) WORK PIECE (1/8 3/4) VISE JAW fig. 2	1. PLACE ONE END OF FIRST 1/8" X 3/4" STRAP ON ONE BEND LINE OF CLIP IN BENCH VISE. SEE FIG. #1 2. PLACE ONE END OF SECOND 1/8" X 3/4" STRAP ON SECOND BEND LINE OF CLIP IN BENCH VISE. SEE FIG. #2 NOTE: POSITION EACH 1/8" X 3/4" STRAP 1/32" BACK OF BEND LINE TO ALLOW FOR MATERIAL THICKNESS
2. BEND WORKPIECE  fig. 3	1. TIGHTEN VISE SLOWLY 2. TIGHTEN UNTIL JAWS ARE CLOSED AS TIGHT AS POSSIBLE 3. REMOVE FROM VISE 4. STRAIGHTEN IF NECESSARY NOTE: PLACE CLIP ON BENCH OR FLAT SURFACE AND LIGHTLY HAMMER TO CORRECT ANGLE. SEE FIG. #3 NOTE: IF A SHEET METAL BRAKE IS AVAILABLE (CAPACITY 11 GA.) THIS WILL PROVIDE BEST METHOD OF BENDING
3. INSPECT	1. CHECK OFFSET DISTANCE TO INSURE 1/16" SPECIFICATION 2. HOLD 11/16" CENTER TO CENTER DISTANCE BETWEEN #12 DRILLED HOLE AND CENTER OF 1/4" R HOLD FOR ASSEMBLY

SKETCHES: DRAWING #10A: PARALLEL CLAMP

REFERENCES: REF. #1, PP. 19-9 TO 19-13
REF. #2, PP. 296-298

TASK SHEET

IV-E-1a (TS)

TASK: ASSEMBLE PARTS OF CLAMP

JOB: C-CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: WORKBENCH, SCREWDRIVER, BALL PEEN HAMMER, CENTER PUNCH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ASSEMBLE HANDLES	1. INSERT 3/16" X 2" ROUND PINS INTO 3/16" HOLE IN SCREW HEAD
	2. TAP LIGHTLY WITH HAMMER IF TIGHT NOTE: MAY ALSO BE PERFORMED CAREFULLY ON ARBOR PRESS
	3. IF LOOSE CENTER PUNCH LIGHTLY AROUND CENTER OF 3/16" PIN SEVERAL TIMES NOTE: ALTERNATE METHOD IS TO KNURL LIGHTLY DURING JOB, VII-C-1a (TS)
2. ASSEMBLE PARTS #1, #3 AND #4, AND #2 AND #5	1. INSERT #1-CLAMP SCREW INTO #0 DRILLED HOLE IN #4-CLAMP JAW
	2. POSITION #3-SCREW RETAINING CLIP INTO 1/16" GROOVE ON PART #1 AND FASTEN WITH #10-32 ROUND HEAD SCREW
	3. SCREW #2-CLAMP SCREW INTO 5/16"-24 THREADED HOLE ON #5-CLAMP JAW
	4. SCREW #2 IN UNTIL END PROTRUDES BEYOND #5 CLAMP JAW (APPROXIMATELY 1")
3. POSITION PARTS #1 AND #4 TOGETHER WITH PARTS #2 AND #5	1. PLACE ASSEMBLED PARTS #1 AND #4 DIRECTLY OVER #2 AND #5
	2. INSERT PART #2 INTO 1/4" DRILLED HOLE ON PART #4
	3. INSERT PART #1 INTO 5/16"-24 THREADED HOLE ON PART #5 NOTE: THE FOUR WILL REQUIRE POSITIONING TOGETHER SIMULTANEOUSLY WITH CLAMP JAWS PARALLEL
4. SCREW CLAMPS TOGETHER	1. REVOLVE CLAMP SCREWS #1 AND #2 CLOCKWISE SIMULTANEOUSLY

	2. CONTINUE TO REVOLVE SCREWS UNTIL CLAMP JAWS COME IN CONTACT
5. INSPECTION	1. CLAMP SCREWS SHOULD TURN FREE AS THEY ARE TURNED DOWN 2. CLAMP JAWS SHOULD BE ALIGNED WHEN CLOSED 3. ALL EDGES SHOULD COINCIDE HAVE INSTRUCTOR INSPECT

SKETCHES: DRAWING #10 AND #10A: PARALLEL CLAMP

REFERENCES: REF. #2, PP. 253-263

MACHINE SHOP C-CLAMP

ENGINE LATHE 9

DRILL PRESS 4

HORIZONTAL MILLING MACHINE 7

BENCH 6

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, OPERATE DESIGNATED MACHINES, AND CONSTRUCT C-CLAMP, ACCORDING TO SPECIFICATIONS

CHECKING STANDARDS

1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
2. HOLD ALL SURFACES TO PRECISION FINISH.
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT.
5. MAINTAIN SAFETY ATTITUDE.

REFERENCES

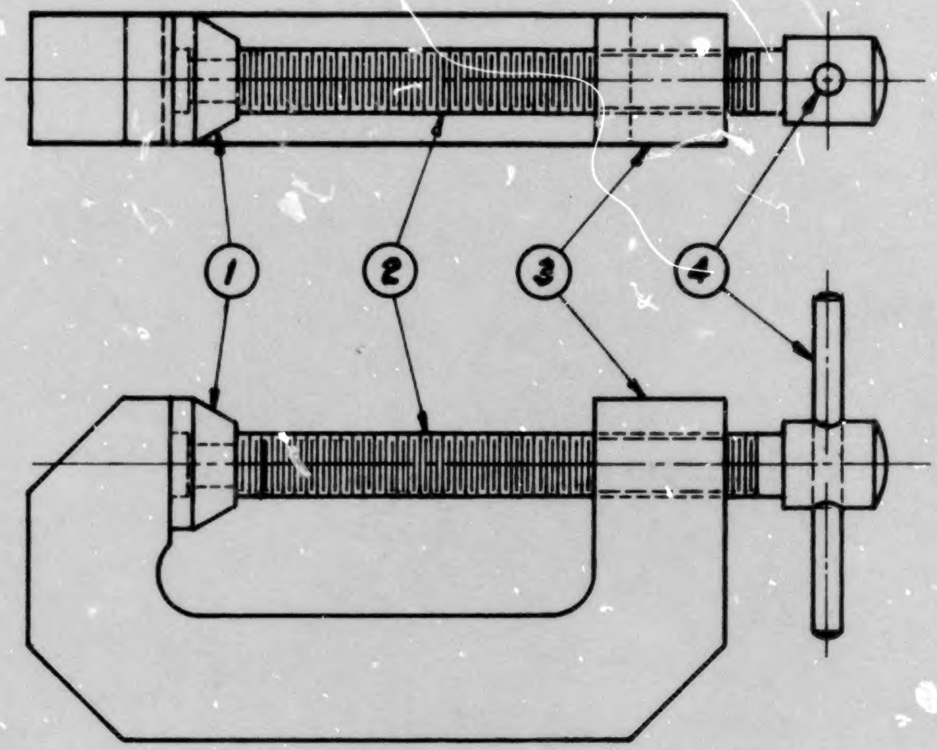
REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWARD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

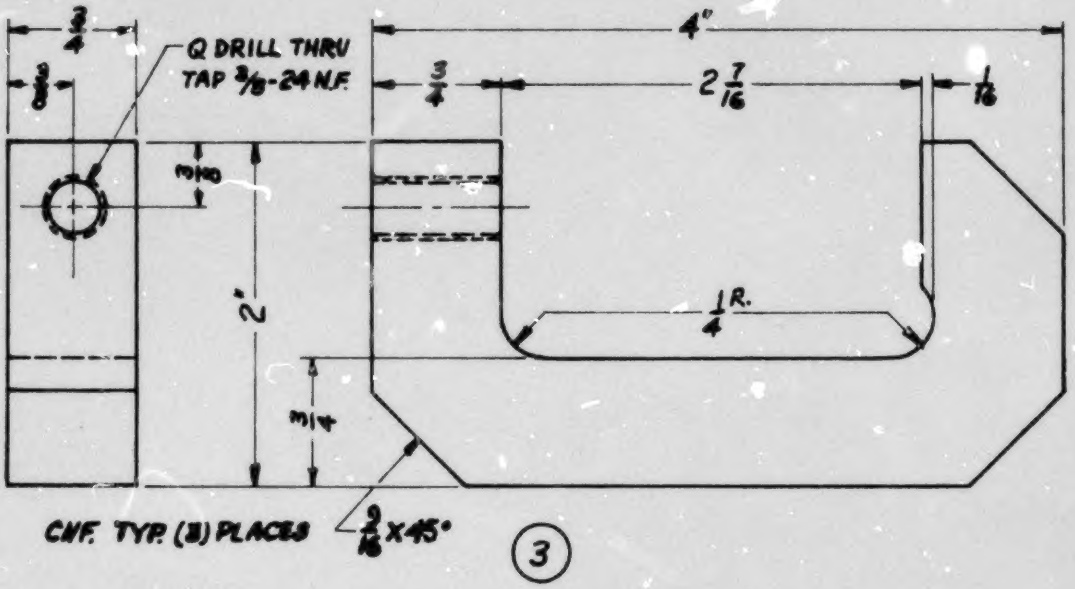
NOTE: IN THIS JOB THE STUDENT IS TO GET ALL NECESSARY MATERIALS FROM MATERIAL SUPPLY PRIOR TO STARTING THE TASKS FOR CONSTRUCTION OF THIS MULTI-PART JOB. THE STUDENT IS CHARGED WITH KEEPING TRACK OF EACH AND ALL PARTS.

JOB AND TASK SHEETS ARE WRITTEN FOR THE COMPLETION OF EACH PART BEFORE PROCEEDING TO THE NEXT PART. UPON COMPLETION OF A PART, STUDENT WILL HOLD THAT PART FOR ASSEMBLY AND PROCEED TO THE NEXT PART.

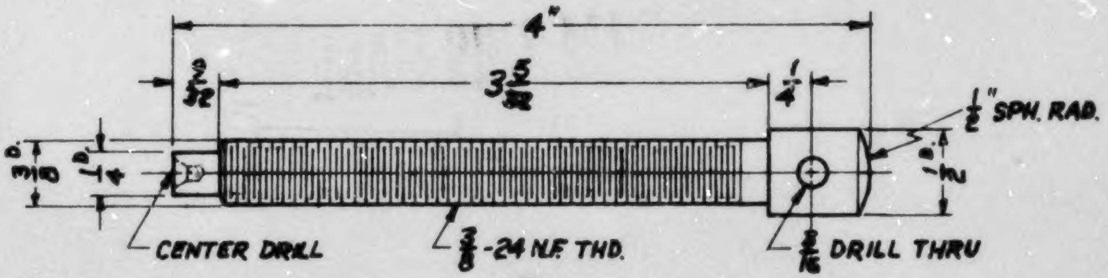


~ASSEMBLY~

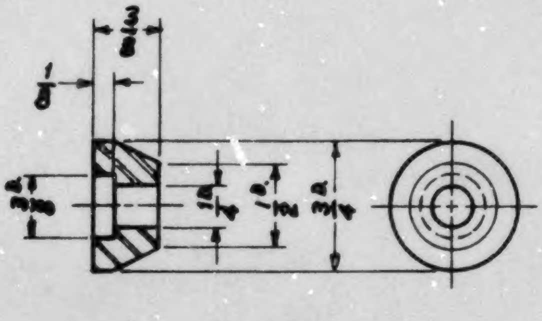
DRAWING NO. 11	C-CLAMP	TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 6 DRILL JOB NO. 4 LATHE JOB NO. 9 MILL JOB NO. 7 SHAPER JOB NO. 3	MATERIAL: C.R. STEEL FINISH: SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

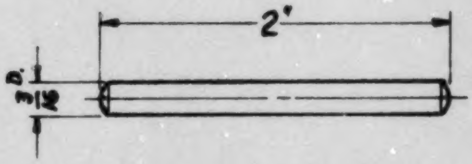

3/4
3/8
Q DRILL THRU
TAP 3/8-24 N.F.
4"
3/4
2 7/16
1/16
3/8
2"
1/4 R.
3/4
CHF. TYP. (3) PLACES 3/16 X 45°

③


4"
3/32
3 5/32
1/4
1/2" SPH. RAD.
3/8 D.
1/4 D.
1/2 D.
CENTER DRILL
3/8-24 N.F. THD.
3/16 DRILL THRU

②


3/8
1/8
3/8 D.
1/4 D.
1/2 D.
3/4 D.



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DRAWING NO. 11A	C-CLAMP DETAILS	TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 6 LATHE JOB NO. 9 SHAPER JOB NO. 3 MILL JOB NO. 7 DRILL JOB NO. 4	MATERIAL: C.R. STEEL FINISH: SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-J-1(J)

JOB SHEET
ON
ENGINE LATHE

JOB:	C-CLAMP	
MATERIAL:	C-CLAMP SCREW, 1/2" X 4 1/8" COLD ROLLED ROUND STEEL	
TOOLS AND EQUIPMENT:	ENGINE LATHE, UNIVERSAL CHUCK, TAILSTOCK DRILL CHUCK AND CHUCK KEY, #1 CENTERDRILL, FACING TOOL, TURNING TOOL, THREADING TOOL, LIVE CENTER, CENTER GAGE, 1/4" CONCAVE RADIUS TOOL, MILL FILE, 0-1" OUTSIDE MICROMETER, BALL PEEN HAMMER, DRILL PRESS, CHUCK AND KEY, VISE, 3/16" DRILL, COMBINATION SQUARE, 6" RULE, SCRIBE, PRICK PUNCH, V-BLOCK, CENTER PUNCH, SCREW PITCH GAGE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, PP. 36-1 TO 36-44; DRILL PRESS, PP. 34-1 TO 34-24; REF. #2, LATHES, PP. 462-494; DRILL PRESS, PP. 193-249; REF. #1, LAYOUT, PP. 6-1 TO 6-10; REF. #2, LAYOUT, PP. 62-72	
PROCEDURES AND/OR TASKS:	VII-B-1(TS)	CHECK LATHE FOR PROPER OPERATING CONDITION
	VII-C-1(TS)	SET UP, FACE, AND CENTERDRILL
	VII-B-1d(TS)	SET UP AND TURN 3/8" DIAMETER 3 7/16" FROM END
	VII-B-1d(TS)	SET UP AND TURN 1/4" DIAMETER 9/32" IN LENGTH
	VII-I-1(TS)	SET UP AND TURN 3/8" -24-NF THREAD
	VII-J-1(TS)	SET UP, FACE, AND TURN 1/2" SPHERICAL RADIUS ON END. CLEAN MACHINE, INSPECT, AND ROUTE TO BENCH
	IV-D-1(TS)	LAY OUT AND LOCATE CENTER FOR 3/16" HOLD ON C-CLAMP SCREW. ROUTE TO DRILL PRESS
	VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	VI-B-1(TS)	SET UP AND DRILL 3/16" HOLE IN C-CLAMP SCREW. CLEAN MACHINE AND HOLD PART FOR ASSEMBLY
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS.	

CHECK POINTS:
(CONT'D.)

1. CHECK MACHINES FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

VII-J-1 (TS)

TASK: SET UP, FACE, AND TURN 1/2" SPHERICAL RADIUS

JOB: C-CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, UNIVERSAL CHUCK, 1/2" CONCAVE RADIUS TOOL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP MACHINE AND WORKPIECE	1. SET SPINDLE SPEED AT 200 RPM 2. MOUNT WORKPIECE IN CHUCK CAUTION: DO NOT TIGHTEN CHUCK TOO TIGHT THEREBY DAMAGING THREAD NOTE: IF SHIM STOCK IS USED TO PROTECT THREADS, INSURE WORKPIECE RUNS TRUE
2. SET UP TOOLING	1. SET RADIUS TOOL AT 45° ANGLE TO WORKPIECE 2. POSITION TOOL ON CENTER OF WORKPIECE
3. TURN RADII	1. PUT SAFETY GLASSES ON 2. FEED RADIUS TOOL IN SLOWLY KEEPING FIRM PRESSURE AGAINST WORKPIECE NOTE: IF TOOL CHATTERS SLOW DOWN SPEED; IF TOOL TEARS WORKPIECE INCREASE SPEED 3. APPLY CUTTING OIL FREELY 4. INSPECT WITH RADIUS GAGE 5. USE MILL FILE TO REMOVE ANY BURRS OR MACHINE MARKS. ROUTE TO BENCH FOR LAYOUT OF 3/16" HOLE

SKETCHES: DRAWING #11a: C-CLAMP

REFERENCES: SEE INSTRUCTOR

VII-J-2(J)

JOB SHEET
ON
ENGINE LATHE

JOB: C-CLAMP

MATERIALS: SWIVEL HEAD, 3/4"^{D} X 1 3/8" COLD ROLLED STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, INDEPENDENT CHUCK, DIAL INDICATOR, TAILSTOCK DRILL CHUCK AND KEY, CENTER DRILL, 1/4" DRILL FACING TOOL, TURNING TOOL, 3/8" COUNTERBORE WITH 1/4" PILOT, PARTING TOOL, 0-1" MICROMETER, 6" RULE, MILL FILE, VERNIER CALIPER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #1, LATHES, PP. 36-1 TO 36-44 AND REFERENCE #2, LATHES, PP. 462-494. CHECK WITH TEACHER BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS: OBTAIN SPECIFIED MATERIAL FROM SUPPLY

VII-B-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-B-1d(TS)	TRUE WORKPIECE WITH 5/8" PROTRUDING FROM JAWS
VII-C-1 (TS)	SET UP, FACE, AND CENTER DRILL WORKPIECE.
VII-D-1 (TS)	SET UP AND DRILL 1/4" HOLE 1/2" DEEP
VII-H-1 (TS)	SET UP 3/8" COUNTERBORE AND COUNTERBORE HOLE 1/8" DEEP
VII-J-2(TS)	SET UP AND TURN 26° 34' ANGLE
	BURR, INSPECT, AND HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINES FOR PROPER OPERATING CONDITIONS
2. CHECK MACHINES FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

TASK: SET UP AND TURN 26° 34' ANGLE

JOB: C-CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, INDEPENDENT CHUCK, PARTING TOOL, 6" RULE, VERNIER CALIPER, TURNING TOOL, MILL FILE, ROUND FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET MACHINE	1. SET SPINDLE SPEED ABOUT 100 RPM
	2. SET CROSS FEED ON .005" NOTE: MAY BE FED BY HAND
2. SET UP TOOLING	1. SET PARTING TOOL IN TOOL POST PERPENDICULAR TO WORKPIECE
	2. SET TOOL POINT ON CENTER OF WORKPIECE
3. POSITION TOOL	1. POSITION RIGHT SIDE OF PARTING TOOL 3/8" FROM END OF WORKPIECE
	2. LOCK CARRIAGE
	3. MOVE TOOL POINT IN UNTIL TOUCHING LIGHTLY THE WORKPIECE
4. TURN 1/2"^{D} RELIEF	1. ENGAGE CROSS FEED NOTE: IF POWER FEED IS NOT USED, HAND FEED TOOL IN SLOWLY
	2. HOLD 1/2" SPECIFIED DIAMETER NOTE: THIS IS ONLY A RELIEF USED TO TURN ANGLE IN NEXT STEP
5. TURN ANGLE	1. SET COMPOUND REST ON 26° 34' NOTE: HAND WHEEL IS TOWARD TAILSTOCK
	2. INCREASE SPEED TO 400 RPM
	3. POSITION TURNING IN TOOL POST
	4. FEED TOOL FROM 3/4"^{D} TOWARD 1/2"^{D} NOTE: HOLD 1/8" FROM END OF WORKPIECE AS SPECIFIED
	5. TURN ANGLE TO FINISHED SIZE
6. CUT SWIVEL OFF	1. RESET UP PARTING TOOL. REFER TO STEPS 1 AND 2

	2. CUT WORKPIECE TO SIZE, VII-A-1b (TS)
7. BURR WORKPIECE	1. REMOVE ALL EXTERIOR BURRS 2. REMOVE ALL INTERIOR BURRS
8. INSPECT	CHECK ALL DIMENSIONS AGAINST SPECIFICATIONS
9. CLEAN MACHINE	REFER TO: VII-A-1c (TS) HOLD FOR ASSEMBLY

SKETCHES: DRAWING #11a: C-CLAMP

REFERENCES:
REF. #1, PP. 36-25 TO 36-28
REF. #2, PP. 483-484
REF. #3, PP. 172-178

VII-J-3(J)

JOB SHEET
ON
ENGINE LATHE

JOB: C-CLAMP

MATERIALS: PIN 3/16"^{D} X 2" COLD ROLLED STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 3/16" COLLET, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, PP. 36-1 TO 36-44; REF. #2, LATHES, PP. 462-494

PROCEDURES AND/OR TASKS: OBTAIN SPECIFIED MATERIAL FROM SUPPLY

	ROUTE TO ENGINE LATHE
VII-B-1(TS)	CHECK LATHE FOR PROPER OPERATING CONDITION
VII-A-1a(TS)	SET UP COLLET ATTACHMENT AND 3/16" COLLET
VII-E-1(TS)	FILE SPHERICAL RADIUS ON BOTH ENDS OF PIN
	INSPECT AND HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

IX-G-1(J)

JOB SHEET
ON
MILLING MACHINE

JOB: C-CLAMP

MATERIALS: CLAMP FRAME 3/4" X 2" X 4", COLD ROLLED STEEL

TOOLS AND EQUIPMENT: LAYOUT BENCH, HEIGHT GAGE, LAYOUT INK, PRICK PUNCH, CENTER PUNCH, BALL PEEN HAMMER, DRILL PRESS, 1/2" DRILL, DRILL CHUCK AND KEY, VISE, HORIZONTAL MILL, 6" RULE, MILLING MACHINE VISE, ARBOR, COLLARS, DIAL INDICATOR, MILL FILE, PARALLEL BARS, 6" STAGGERED TOOTH SIDE MILLING CUTTER, 3/8"-24 NF PLUG TAP, TAP WRENCH, "Q" DRILL, COMBINATION SQUARE, SOFT FACE HAMMER, SCRIBE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LAYOUT, PP. 6-1 TO 6-10, DRILL PRESS, PP. 34-1 TO 34-24; MILLING MACHINE, PP. 38-1 TO 38-38; REF. #2, LAYOUT, PP. 62 TO 72; DRILL PRESS, PP. 193-249, MILLING MACHINE, PP. 524-564
CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES

PROCEDURES AND/OR TASKS:

	OBTAIN MATERIAL FROM SUPPLY
	ROUTE TO LAYOUT BENCH
IV-C-1(TS)	LAY OUT CLAMP FRAME
IV-B-1(TS)	LAY OUT AND LOCATE CENTERS FOR 1/4" RADIUS
	NOTE: DRILL CENTER WITH 1/2" DRILL TO COMPLETE 1/4" RADIUS
IV-D-1(TS)	LAYOUT AND LOCATE CENTER FOR 3/8"-24 NF THREAD
	ROUTE TO DRILL PRESS
VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VI-A-1a(TS)	SET UP MACHINE AND WORKPIECE
VI-C-1(TS)	SET UP AND DRILL 2-1/2" HOLES
	NOTE: THIS FORMS THE 1/4" RADIUS
VI-C-1(TS)	SET UP AND DRILL "Q" SIZE HOLES TO BE TAPPED 3/8"-24 NF LATER
	ROUTE TO HORIZONTAL MILL
IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-A-1a(TS)	SET UP MACHINE AND WORKPIECE

PROCEDURES AND/OR TASKS: (CONT'D.)	IX-G-1(TS)	SET UP AND MACHINE BODY OF CLAMP FRAME
	IX-F-1(TS)	SET UP AND MACHINE ANGLES OF CLAMP BODY
	IX-A-1c(TS)	REMOVE WORKPIECE, DEBURR, AND CLEAN MACHINE
		ROUTE TO BENCH FOR TAPPING HOLE
	IV-D-1a(TS)	TAP 3/8"-24 NF THREAD IN THE END OF CLAMP FRAME
		HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINES FOR PROPER OPERATING CONDITIONS
2. CHECK MACHINES FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET IX-G-1(TS)

TASK: SET UP AND MACHINE BODY OF CLAMP FRAME

JOB: C-CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, MILL VISE, DIAL INDICATOR, PARALLEL BARS, ARBOR, COLLARS, 6" STAGGERED TOOTH SIDE MILLING CUTTER, SOFT FACE HAMMER, 6" RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP VISE	REFER TO: IX-E-1(TS)
2. SET UP MILLING CUTTER	REFER TO: IX-A-1a(TS)
3. SET SPEED AND FEED	SEE CHART REF. #1, P. 38-16; REF. #2 PP. 549-550
4. MACHINE BODY	1. PUT SAFETY GOGGLES ON 2. MACHINE TO LAYOUT LINES. REFER TO: II-A-1c(TS) NOTE: ALL MILL CUTS SHOULD BLEND INTO CURVE OF 1/4" RADII ON THE SIDE AND BOTTOM OF CLAMP 3. SET DEPTH OF CUT AS DEEP AS MACHINE WILL TAKE WITHOUT OVER WORKING NOTE: MAINTAIN AND HOLD 2 7/16" ON WIDTH AND 2" ON DEPTH 4. REMOVE FROM VISE AND DEBURR
5. RESET UP FOR MACHINING ANGLES	REFER TO: IX-F-1(TS)

SKETCHES: DRAWING #11a: C-CLAMP

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

IV-F-1(J)

JOB SHEET
ON
BENCH

JOB: C-CLAMP

MATERIALS: PART #1-SWIVEL, PART #2-CLAMP SCREW, PART #3-CLAMP FRAME, PART #4-C-CLAMP PIN

TOOLS AND EQUIPMENT: SPECIAL SWEDGING TOOL, CENTER PUNCH, BALL PEEN HAMMER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 253-263

PROCEDURES AND/OR TASKS: IV-F-1(TS) ASSEMBLE PARTS #1, 2, 3, AND 4

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK ALL PARTS FOR COMPLETION
2. CHECK ALL PARTS FOR SPECIFICATIONS
3. CHECK FOR PROCEDURE IN ASSEMBLY
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS
5. SAFE WORKING HABITS

TASK SHEET

IV-F-1(TS)

TASK: ASSEMBLE PARTS OF C-CLAMP

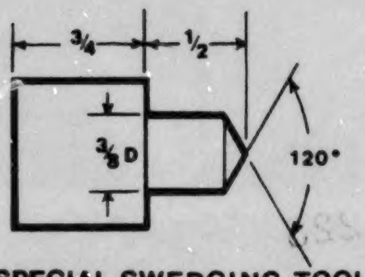
JOB: C-CLAMP

TRADE: MACHINIST

TOOLS AND MATERIALS: PART #1 - SWIVEL, PART #2 - CLAMP SCREW, PART #3 - CLAMP FRAME, PART #4 - CLAMP PIN, SPECIAL SWEDGING TOOL, CENTER PUNCH, BALL PEEN HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ASSEMBLE HANDLE	1. INSERT 3/16" X 2" ROUND PIN INTO 3/16" HOLE IN SCREW HEAD 2. TAP IN LIGHTLY WITH HAMMER IF TIGHT NOTE: THIS MAY ALSO BE DONE CAREFULLY ON THE ARBOR PRESS 3. IF LOOSE CENTER PUNCH LIGHTLY AROUND CENTER OF 3/16" PIN SEVERAL TIMES NOTE: AN ALTERNATE METHOD IS TO KNURL LIGHTLY THE PIN REFER TO: VII-C-1a(TS)
2. ASSEMBLE CLAMP SCREW AND CLAMP	1. INSPECT THREADS ON PARTS FOR BURRS, SHAVINGS, DIRT 2. SCREW BOLT INTO CLAMP BODY NOTE: BOLT MUST TURN FREELY BY HAND 3. TURN BOLT IN APPROXIMATELY HALFWAY
3. ASSEMBLE SWIVEL ONTO CLAMP SCREW	1. INSERT SWIVEL ONTO CLAMP SCREW NOTE: 1/4" HOLE ON SWIVEL MUST FIT LOOSE ON 1/4" TURN END OF SCREW 2. INSERT SWEDGING TOOL BETWEEN SWIVEL AND CLAMP FRAME NOTE: SWEDGING TOOL IS SHOP MADE AND CAN BE MADE OF MOST ANY MATERIAL. THE PURPOSE OF THIS TOOL IS TO FLARE OR SWEDGE THE CENTER DRILLED HOLE AND END OF 1/4" DIAMETER OF CAP. THIS WILL LOCK CAP



SPECIAL SWEDGING TOOL

ON BOLT AND PERMIT IT TO SWIVEL FREELY

3. TIGHTEN CLAMP SCREW AND SWIVEL AGAINST SWEDGE TOOL TO FLARE SCREW
   CAUTION: IF SCREW DOES NOT FLARE DO NOT FORCE SCREW, BUT APPLY A LITTLE HEAT TO SCREW END, TAP LIGHTLY WITH HAMMER AND PUNCH
4. SWEDGE UNTIL SCREW IS FLARED SMOOTHLY AGAINST SWIVEL
   CAUTION: DO NOT OVERSWEDGE AS THE SWIVEL WILL NOT TURN

SKETCHES: DRAWING #11 AND 11a: C-CLAMP

REFERENCES: REF. #2, PP. 253-263

MACHINE SHOP TOOL MAKER'S VISE

ENGINE LATHE 10

DRILL PRESS 5

HORIZONTAL MILLING MACHINE 8

BENCH 7

AIM:	THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, OPERATE DESIGNATED MACHINES, AND CONSTRUCT A TOOL MAKER'S VISE, ACCORDING TO SPECIFICATIONS

CHECKING STANDARDS

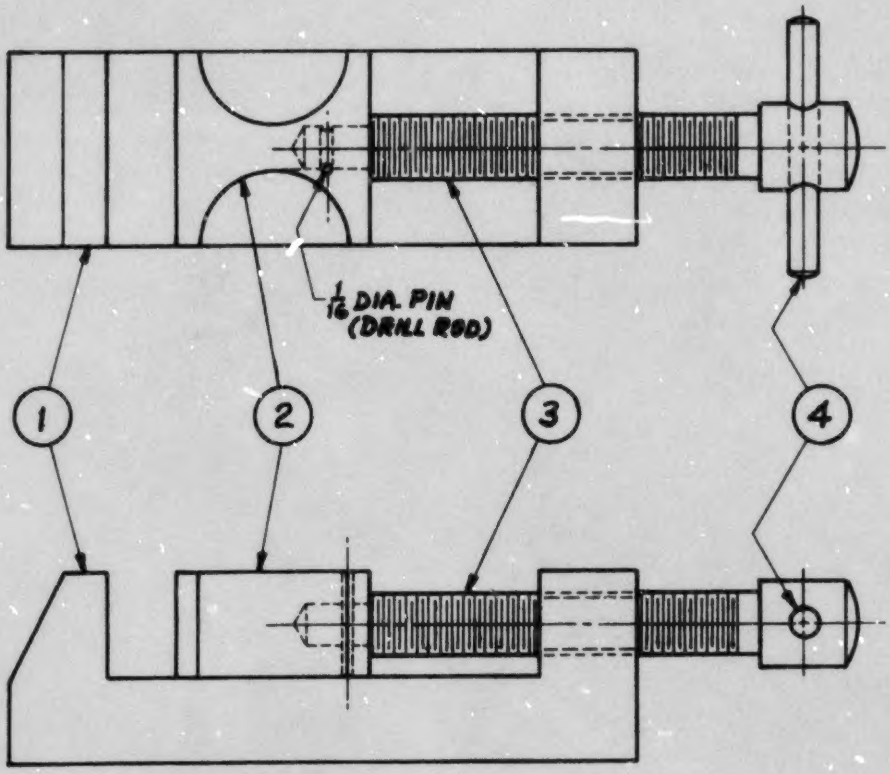
1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
2. HOLD ALL SURFACES TO PRECISION FINISH.
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT.
5. MAINTAIN A SAFETY ATTITUDE.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

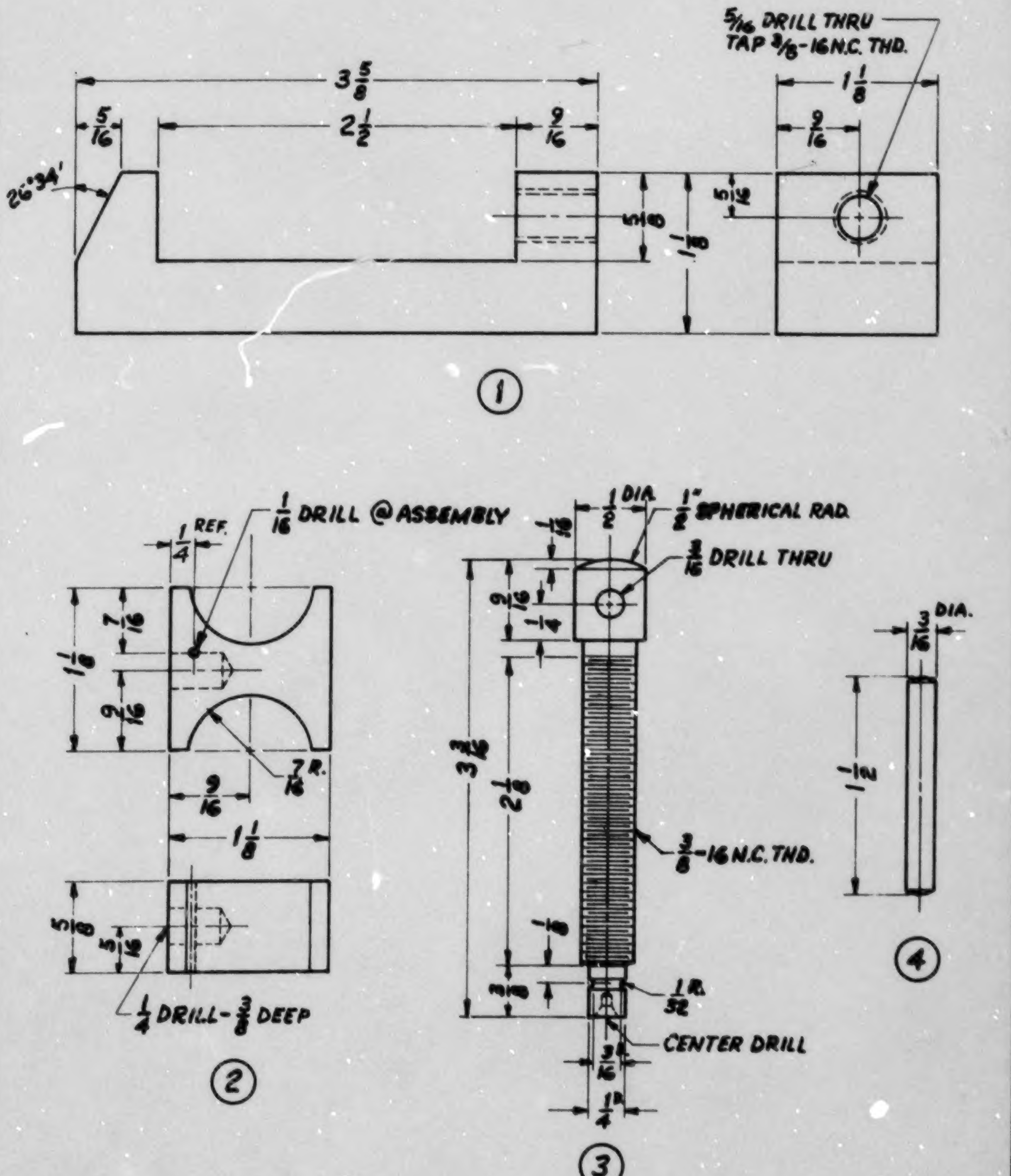
REF. #2, LUDWIG, OSWALD A. AND MCCARTHY, WILLARD J. METALWORK TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS


$\frac{1}{16}$ DIA. PIN
(DRILL ROD)
1
2
3
4

~ ASSEMBLY ~

DRAWING NO. 12	TOOL MAKERS VICE	TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 7 LATHE JOB NO. 10 SHAPER JOB NO. 4 MILL JOB NO. 8 DRILL JOB NO. 5	MATERIAL: MILD STEEL C.R. FINISH: SEE DETAILS SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4 °


5/16 DRILL THRU
TAP 3/8-16N.C. THD.
3 5/8
1 1/8
5/16
2 1/2
9/16
9/16
26°34'
5/16
5/8
1 1/8
5/16
1
1/16 DRILL @ASSEMBLY
1/4 REF.
7/16
1 1/8
9/16
7/16 R.
9/16
1 1/8
5/8
5/16
1/4 DRILL-3/8 DEEP
2
1/2 DIA.
1/16
1" /2 SPHERICAL RAD.
3/16 DRILL THRU
9/16
1/4
3 3/16
2 1/8
3/8-16N.C. THD.
1/8
3/16
1/32 R.
CENTER DRILL
3/16 R.
1/4 R.
3
3/16 DIA.
1 1/32
4

DRAWING NO.		TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 7 LATHE JOB NO. 10 SHAPER JOB NO. 4 MILL JOB NO. 8 DRILL JOB NO. 5	MATERIAL: MILD STEEL C.R. FINISH: SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4 °

IX-H-1(J)

JOB SHEET
ON
MILLING MACHINE

JOB: TOOL MAKER'S VISE

MATERIALS: 1 PIECE 1 1/4" X 1 1/4" X 3 3/4" MILD STEEL

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, ARBOR AND SPACERS, DIAL INDICATOR, FILE, 6" RULE, MICROMETER, PARALLEL BARS, 2" X 4" PLAIN MILLING CUTTER, AND COMBINATION SQUARE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 38-1 TO 38-38 AND REF. #2, PP. 524-564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS: OBTAIN SPECIFIED MATERIAL FROM MATERIAL STORAGE

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-A-1a(TS)	SET UP MACHINE AND MILL VISE
IX-A-1a(TS)	SET UP MACHINE WITH PLAIN MILLING CUTTER
IX-H-1(TS)	SET UP WORKPIECE AND MACHINE WORKPIECE SQUARE AND PARALLEL TO SPECIFIED SIZE
IX-E-1a(TS)	SET UP MACHINE WITH SIDE MILLING CUTTER
IX-A-1b(TS)	SET UP WORKPIECE AND MACHINE INSIDE. NOTE: HOLD SPECIFIED TOLERANCE
IX-F-1(TS)	SET UP AND MACHINE 26°34' ANGLE, CLEAN MACHINE, INSPECT, AND ROUTE TO BENCH
IV-D-1(TS)	LAY OUT AND LOCATE CENTER FOR 3/8"-16NC THREAD ROUTE TO DRILL PRESS
VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VI-A-1a(TS)	SET UP MACHINE AND WORKPIECE
VI-C-1(TS)	SET UP AND DRILL 5/16" HOLE AS SPECIFIED. ROUTE TO BENCH FOR TAPPING HOLD
IV-D-1a(TS)	TAP 3/8" - 16NC THREAD HOLD FOR ASSEMBLY

TASK SHEET IX-H-1(TS)

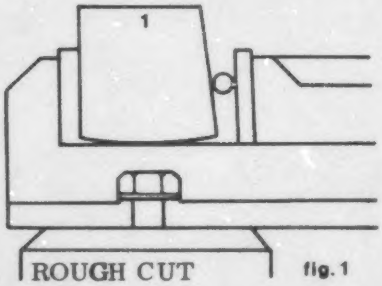
TASK: SET UP WORKPIECE, MACHINE AND SQUARE TO SPECIFIED SIZE

JOB: TOOLMAKER'S VISE

TRADE: MACHINIST

TOOLS AND MATERIALS: 1 PIECE - 1 1/4" X 1 1/4" X 3 3/4" MILD STEEL, HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, ARBOR WITH COLLARS, DIAL INDICATOR, FILE, 6" RULE, 1" - 2" MICROMETER, PARALLEL BARS, 2" X 4" PLAIN MILLING CUTTER, COMBINATION SQUARE, SOFT FACE HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE	1. REFER TO: IX-E-1(TS) NOTE: PLACE PARALLEL BARS BENEATH WORKPIECE SO TOP IS ABOVE TOP OF VISE JAWS SEE FIG. 1
2. SET SPEED AND FEED	SEE CHART REF. #1, PP. 38-16, OR REF. #2, PP. 549-550
3. POSITION WORK FOR FIRST BROAD SURFACE, SIDE #1  fig. 1	1. POSITION CUTTER OVER WORKPIECE 2. CUT MACHINE ON CAUTION: CHECK THAT CUTTER IS CLEAR WORKPIECE 3. RAISE TABLE UNTIL CUTTER CONTACTS WORKPIECE NOTE: CHECK CORRECT CUTTER ROTATION 4. CLEAR CUTTER BY MOVING TABLE LONGITUDINALLY NOTE: CHECK CUTTER ROTATION WITH RESPECT TO TABLE DIRECTION
4. ROUGH CUT	1. RAISE TABLE .050 OR ENOUGH TO CLEAN UP WORKPIECE 2. TURN COOLANT ON 3. HAND FEED UNTIL CUTTER REACHES FULL DEPTH 4. ENGAGE AUTOMATIC FEED 5. UPON COMPLETION OF CUT a. DISENGAGE AUTOMATIC FEED b. LOWER TABLE ONE ROUND TO CLEAR CUTTER

c. RETURN TABLE TO STARTING POSITION
d. RETURN TABLE SETTING TO ORIGINAL HEIGHT SETTING

5. FINISH CUT

1. RAISE TABLE .015"
2. ADJUST MACHINE FEED AND SPEED FOR FINISH CUT
   NOTE: REFER TO CHART REF. #1, PP. 38-16, OR REF. #2, PP. 549-550
3. HAND FEED UNTIL CUTTER REACHES FULL DEPTH
4. ENGAGE AUTOMATIC FEED
5. UPON COMPLETION OF CUT
   a. TURN MACHINE AND COOLANT OFF
   b. REMOVE WORKPIECE
   c. BURR EDGES
   d. BRUSH AND WIPE OFF VISE

6. POSITION WORKPIECE

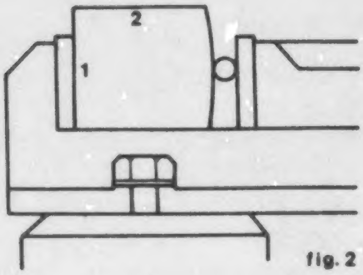


fig. 2

1. TURN VISE SO JAWS ARE PARALLEL WITH MACHINED FACE OF COLUMN
2. CLEAN VISE JAWS AND BASE
3. LAY PARALLEL BARS ON BOTTOM OF VISE
4. PLACE MACHINE SURFACE AGAINST STATIONARY VISE JAW, SEE FIG. 2
   NOTE: PROTECT WITH SHIM STOCK IF JAWS ARE ROUGH
5. PLACE SOFT ROD BETWEEN MOVABLE JAW AND WORKPIECE AND TIGHTEN VISE
6. FOLLOW MACHINING PROCEDURE AS IN STEPS #4 AND #5

7. POSITION WORKPIECE TO MACHINE SECOND EDGE, SIDE #3

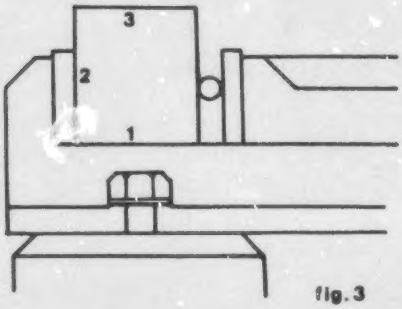


fig. 3

1. LOOSEN VISE AND REMOVE WORKPIECE
2. WIPE VISE CLEAN
3. REMOVE BURRS WITH FILE
4. TURN WORKPIECE END FOR END
   NOTE: FIRST MACHINED EDGE SHOULD BE POSITIONED AT BOTTOM OF VISE, AND FIRST MACHINED BROAD SURFACE POSITIONED AGAINST STATIONARY VISE JAW, SEE FIG. 3
   NOTE: WORKPIECE MAY BE PLACED ON BOTTOM OF VISE PROVIDED THERE IS SUFFICIENT MATERIAL ABOVE VISE TO CLEAR FINISH CUT TO SIZE

5. PLACE SOFT ROD BETWEEN WORKPIECE AND MOVABLE JAW. TIGHTEN VISE
CAUTION: CHECK TO INSURE THAT THE TWO MACHINED SURFACES ARE AGAINST THE VISE JAW AND BOTTOM

8. MACHINE SECOND EDGE

1. FOLLOW MACHINING PROCEDURES AS IN STEPS #4 AND #5
NOTE: HOLD 1 1/8" SPECIFIED DIMENSION

9. POSITION WORKPIECE FOR SECOND BROAD SURFACE, SIDE #4

1. REVOLVE VISE 90° SO VISE JAWS ARE PERPENDICULAR TO COLUMN
2. PLACE WORKPIECE ON PARALLELS WITH FINISHED BROAD SURFACE DOWN
3. TIGHTEN VISE JAWS AGAINST TWO FINISHED EDGES
CAUTION: CHECK TO INSURE THAT BOTH EDGES ARE FLUSH AGAINST VISE JAWS
NOTE: WITH THREE FINISHED SURFACES THE ROUND ROD IS NOT REQUIRED TO MACHINE SIDE #4, SEE FIG. 4

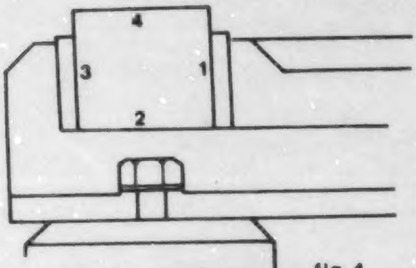


fig. 4

10. MACHINE SIDE #4

1. FOLLOW MACHINING PROCEDURES AS IN STEPS #4 AND #5
NOTE: INSPECT AND HOLD SPECIFIED DRAWING DIMENSION 1 1/8"

11. POSITION WORKPIECE TO MACHINE FIRST END, SIDE #5

1. REVOLVE VISE 90° SO VISE JAWS ARE PARALLEL TO FACE OF COLUMN
2. PLACE ONE END OF WORKPIECE ON PARALLEL OR BOTTOM OF VISE
3. PLACE SQUARE AGAINST ONE EDGE OF WORK PIECE AND TEST FOR SQUARENESS
NOTE: PARALLEL MAY BE USED TO POSITION SQUARE OR TO CLEAR VISE, SEE ILLUSTRATION #5
NOTE: SHOULD WORKPIECE NOT BE SQUARE OR PERPENDICULAR, SHIM UNDER LOW CORNER UNTIL EDGE IS PERPENDICULAR
CAUTION: SHOULD EDGE NOT BE PERPENDICULAR, THE ENDS WILL NOT BE AT RIGHT ANGLES TO EDGES
NOTE: FINAL TEST FOR CLOSE TOLERANCE WORK MAY BE MADE WITH A DIAL INDICATOR

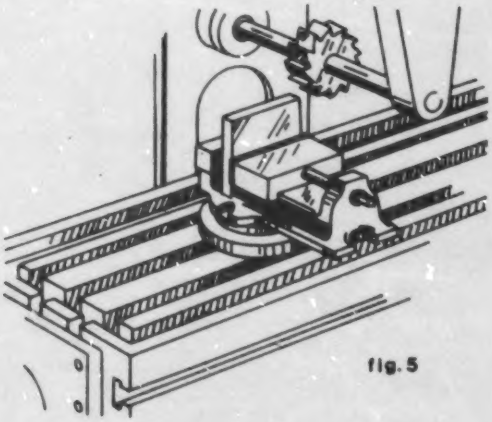


fig. 5

STOCK IN POSITION FOR MACHINE EDGE

12.	MACHINE FIRST END, SIDE #5	1.	FOLLOW MACHINING PROCEDURES AS IN STEPS #4 AND #5
13.	POSITION WORKPIECE TO MACHINE SECOND END, SIDE #6	1. 2. 3.	TURN WORKPIECE END FOR END CLAMP SECURELY IN VISE CHECK FOR SQUARENESS AS IN STEP #11, KEYPOINT 3
14.	MACHINE FIRST END, SIDE #6	1.	FOLLOW MACHINING PROCEDURES AS IN STEPS #4 AND #5 NOTE: HOLD SPECIFIED 3 5/8" FINISHED DIMENSION
15.	INSPECT	1. 2. 3.	REMOVE ALL BURRS CHECK FOR SQUARENESS CHECK ALL DIMENSIONS. REFER TO IX-A-1c(TS)

SKETCH: DRAWING #12-A, TOOL MAKER'S VISE

REFERENCES: REF. #1, PP. 38-5 TO 38-7
REF. #2, PP. 542 AND 554

JOB SHEET
ON
MILLING MACHINE

JOB: TOOL MAKER'S VISE

MATERIALS: 1 PIECE 3/4" X 1 1/4" X 1 1/4" MILD STEEL

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, MILLING SWIVEL VISE, ARBORS AND COLLARS, 7/8" CONVEX MILLING CUTTER, PARALLEL BARS, DIAL INDICATOR, 6" RULE, SOFT FACE HAMMER, DEPTH MICROMETER, COMBINATION SQUARE, LAYOUT DYE, SCRIBE, CENTER PUNCH, 1/4" DRILL, DRILL PRESS, VISE, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 38-1 TO 38-38 AND REF. #2, PP. 524-564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:	IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	IX-A-1a(TS)	SET UP MACHINE WITH PLAIN MILLING CUTTER
	IX-H-1(TS)	SET UP WORKPIECE AND MACHINE WORKPIECE SQUARE AND PARALLEL NOTE: HOLD SPECIFIED TOLERANCES
	IX-A-1a(TS)	SET UP MACHINE WITH CONVEX MILLING CUTTER
	IX-H-2(TS)	SET UP WORKPIECE AND MACHINE 7/8" GROOVE AS PER DRAWING CLEAN MACHINE, INSPECT, AND ROUTE TO BENCH
	IV-D-1(TS)	LAY OUT AND LOCATE CENTER FOR 1/4" DRILLED HOLE
	IV-D-1a(TS)	LAY OUT AND LOCATE CENTER FOR 1/16" DRILLED HOLE
	VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITIONS
	VI-C-1(TS)	SET UP MACHINE AND WORKPIECE AND DRILL 1/4" HOLE AS SPECIFIED. HOLD FOR ASSEMBLY

TASK SHEET IX-H-2(TS)

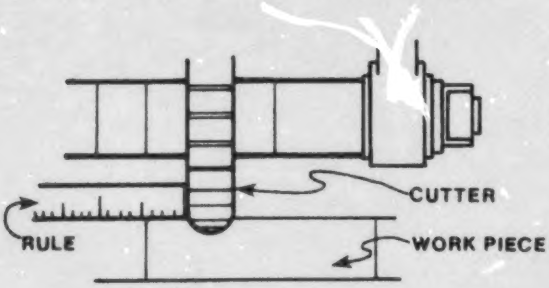
TASK: SET UP WORKPIECE AND MACHINE 7/8" GROOVE AS PER DRAWING

JOB: TOOL MAKER'S VISE

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, MILL VISE, ARBOR AND COLLARS, 7/8" CONVEX MILLING CUTTER, PARALLEL BARS, DIAL INDICATOR, 6" RULE, SOFT FACE HAMMER, DEPTH MICROMETER OR DEPTH GAGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE TO MACHINE FIRST 7/16"^{R} GROOVE	1. REFER TO: IX-E-1(TS) 2. REVOLVE OR POSITION VISE JAWS PERPENDICULAR TO FACE OF COLUMN 3. CHECK ALIGNMENT WITH DIAL INDICATOR 4. PLACE WORKPIECE IN VISE ON ONE EDGE NOTE: VISE JAWS MUST CLEAR 7/16" DEPTH CUT
2. CENTER CONVEX CUTTER  ig.1	1. POSITION CUTTER OVER WORKPIECE. REFER TO: IX-H-1(TS) STEP #3 2. LAY 6" RULE ON TOP OF WORKPIECE. HOLD 1/8" FROM FRONT EDGE, SEE FIG.1 3. MOVE CUTTER UNTIL OUTSIDE OF CUTTER TOUCHES END OF RULE NOTE: ONE METHOD WOULD BE TO SET CUTTER AT FULL DEPTH. MOVE OUTSIDE EDGE OF WORK AGAINST INSIDE OF CUTTER. RAISE CUTTER TO CLEAR WORKPIECE AND MOVE TABLE OUT 1.000" TO CENTER CUTTER
3. MACHINE 7/16"^{R} GROOVE	1. RAISE TABLE .100" NOTE: INSPECT FOR CENTER OF CUTTER BY MEASURING EDGES OF CUT FROM EDGE OF WORKPIECE 2. MACHINE TO TOTAL DEPTH OF 7/16" 3. REMOVE WORKPIECE FROM VISE 4. CLEAN VISE 5. BURR EDGES OF WORKPIECE

4. SET UP WORKPIECE TO MACHINE SECOND 7/16"^{R} GROOVE	1. TURN WORKPIECE END FOR END NOTE: HOLD SAME REFERENCE EDGE WITH STATIONARY JAW, SEE FIG. 1 2. FOLLOW SAME PROCEDURE AS IN FIRST GROOVE NOTE: HOLD SPECIFIED DIMENSIONS AS PER DRAWING
5. INSPECT	1. REMOVE ALL BURRS 2. INSPECT FOR CORRECT DEPTH AND LOCATION OF GROOVE
6. CLEAN MACHINE	REFER TO: IX-A-1c(TS)

SKETCH: DRAWING #12-A, TOOL MAKER'S VISE

REFERENCES: REF. #1, PP. 38-5 TO 38-7
REF. #2, PP. 542-554

VII-K-1(J)

JOB SHEET
ON
ENGINE LATHE

JOB: TOOL MAKER'S VISE

MATERIALS: TOOL MAKER'S VISE SCREW - 1/2" X 3 5/16" COLD ROLLED ROUND STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, UNIVERSAL CHUCK, TAILSTOCK DRILL CHUCK, CHUCK KEY, #1 CENTER DRILL, FACING TOOL, TURNING TOOL, THREADING TOOL, LIVE CENTER, CENTER GAGE, 1/4" CONCAVE RADIUS TOOL, MILL FILE, 0-1" OUTSIDE MICROMETER, 3/16" DRILL, 6" RULE, DRILL PRESS, CHUCK AND KEY, VISE, V-BLOCKS, CENTER PUNCH, SCREW PITCH GAGE, BALL PEEN HAMMER, PRICK PUNCH

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #1, LATHES, PP. 36-1 TO 36-44; DRILL PRESS, PP. 34-1 TO 34-24; LAYOUT, PP. 6-1 TO 6-10; REF. #2 LATHES, PP. 462-494; DRILL PRESS, PP. 193-249; LAYOUT, PP. 62-72

PROCEDURES AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL
VII-B-1d(TS)	SET UP AND TURN 3/8" DIAMETER NOTE: HOLD 2 5/8" LENGTH
VII-B-1d(TS)	SET UP AND TURN 1/4" DIAMETER 3/8" LONG
VII-I-1(TS)	SET UP AND TURN 3/8" - 24NF THREAD
VII-F-1b(TS)	SET UP AND TURN 1/32"^{R} GROOVE 1/8" ON CENTER FROM END OF THREAD NOTE: HOLD 3/16" DIAMETER
VII-J-1(TS)	SET UP, FACE, AND TURN 1/2" SPHERICAL RADIUS
VII-A-1c(TS)	CLEAN MACHINE INSPECT AND ROUTE TO BENCH
IV-D-1(TS)	LAY OUT AND LOCATE CENTER FOR 3/16" HOLE ROUTE TO DRILL PRESS
VI-A-1(TS)	CHECK OPERATING CONDITION OF MACHINE
VI-B-1(TS)	SET UP WORKPIECE AND DRILL 3/16" HOLE THROUGH BURR AND HOLD FOR ASSEMBLY

CHECK POINTS:

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

VII-K-2(J)

JOB SHEET
ON
ENGINE LATHE

JOB: TOOL MAKER'S VISE

MATERIALS: PIN - 3/16" X 2" COLD ROLLED ROUND STEEL - 1 PIECE

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 3/16" COLLET, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #1, LATHES, PP. 36-1 TO 36-44; REFERENCE # 2, LATHES, PP. 462-494

PROCEDURES AND/OR

	OBTAIN SPECIFIED MATERIAL FROM SUPPLY ROUTE TO ENGINE LATHE
VII-A-1(TS)	CHECK LATHE FOR PROPER OPERATING CONDITION
VII-A-1a(TS)	SET UP COLLET ATTACHMENT AND 3/16" COLLET
VII-I-2(TS)	FILE SPHERICAL RADIUS ON BOTH ENDS OF PIN INSPECT AND HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

VI-D-1(J)

JOB SHEET
ON
DRILL PRESS

JOB: TOOL MAKER'S VISE

MATERIALS: PART #2- MOVABLE JAW AS MACHINED ON MILLING MACHINE
PART #3- VISE SCREW AS MACHINED ON LATHE

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL PRESS VISE, CHUCK AND KEY 1/16" DRILL, V-BLOCK AND CLAMP, PARALLEL BARS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, DRILLING, PP. 34-1 TO 34-24; REF. #2, DRILLING, PP. 253-263. CHECK WITH INSTRUCTOR PRIOR TO DRILLING HOLE

PROCEDURES AND/OR TASKS:

VI-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VI-D-1(TS)	SET UP WORKPIECE AND ASSEMBLE DRILL 1/16" HOLE ROUTE TO BENCH FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK FOR PROPER SETUP
3. HOLD ALL DIMENSIONS TO SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS
5. SAFE WORKING HABITS

TASK SHEET VI-D-1(TS)

TASK:	SET UP WORKPIECE AND ASSEMBLE DRILL 1/16" HOLE
JOB:	TOOL MAKER'S VISE
TOOLS AND MATERIALS:	DRILL PRESS, DRILL PRESS VISE, CHUCK AND KEY, 1/16" DRILL, V-BLOCK AND CLAMP, PARALLEL BARS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE PART #2 (MOVABLE JAW)	1. POSITION PART #2 (MOVABLE JAW) IN DRILL VISE NOTE: 1/4" DRILLED HOLE MUST BE PARALLEL TO VISE JAWS 2. TIGHTEN VISE FIRMLY CAUTION: CHECK TO INSURE WORKPIECE IS LEVEL AND SQUARE WITH VISE
2. SET UP WORKPIECE PART #3 (VISE SCREW)	1. INSERT 1/4"^{D} END OF SCREW INTO 1/4" HOLE ON PART #2 NOTE: DIMENSIONS ON BOTH PARTS MUST BE CORRECT TO INSURE THAT 1/16" DRILL WILL PASS THROUGH 1/32"^{R} GROOVE ON PART #3 2. PLACE THREADED END OF PART #2 ON V-BLOCK AND CLAMP WITH V-BLOCK CLAMP NOTE: PARALLELS MAY BE USED TO OBTAIN PROPER HEIGHT AND TO INSURE THAT PART IS LEVEL 3. CHECK TO INSURE SCREW IS PERPENDICULAR TO PART #2
3. DRILL WORKPIECE	1. CHUCK 1/16" DRILL IN DRILL CHUCK AND TIGHTEN FIRMLY 2. POSITION WORKPIECE DIRECTLY UNDER LAYOUT MARK FOR 1/16" DRILL 3. SET DRILL SPEED. REFER TO CHART FIG. 7-37B, P. 105, REF. #3 4. DRILL 1/16" HOLE CAUTION: FEED DRILL SLOWLY AND KEEP DRILL LUBRICATED TO AVOID BREAKING DRILL OR BENDING DRILL NOTE: BE ESPECIALLY CAREFUL IN DRILLING THROUGH GROOVE, AS THE

		GROOVE SERVES AS A GUIDE FOR DRILL PENETRATING 1/4" HOLE
4. BURR AND INSPECT	1.	REMOVE FROM VISE AND V-BLOCKS
	2.	BURR HOLE WITH FILE
	3.	INSPECT DRILLED HOLE ON BOTH PARTS NOTE: INSPECT TO INSURE STRAIGHTNESS OF HOLE AND ALIGNMENT WITH 1/32^R GROOVE ON PART #3
		ROUTE TO BENCH FOR FINAL ASSEMBLY

SKETCH: DRAWINGS #12 AND #12-A, TOOL MAKER'S VISE

REFERENCES: REF. #1, PP. 34-1 TO 34-24
REF. #2, PP. 193-249

IV-G-1(J)

JOB SHEET
ON
BENCH

JOB: TOOL MAKER'S VISE

MATERIALS:
PART #1 AS MACHINED
PART #2 AS MACHINED
PART #3 AS MACHINED
PART #4 AS MACHINED
1/16" X 5/8" PIN

TOOLS AND EQUIPMENT: DRILL PRESS, LAYOUT TOOLS, DRILL PRESS VISE, CENTER PUNCH, BALL PEEN HAMMER, 1/16" DRILL

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #2, PP. 253-263. CHECK WITH INSTRUCTOR PRIOR TO ASSEMBLING PARTS

PROCEDURES AND/OR TASKS:

IV-F-1(TS)	ASSEMBLE PART #3 AND #4. REFER TO STEP #1
IV-G-1(TS)	ASSEMBLE AND LOCK PARTS #2 AND #3 WITH 1/16" STEEL PIN
IV-F-1(TS)	ASSEMBLE PARTS #1 AND #3

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS TO SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS
5. SAFE WORKING HABITS

TASK SHEET IV-G-1(TS)

TASK: ASSEMBLE AND LOCK VISE SCREW AND MOVABLE VISE JAW

JOB: TOOL MAKER'S VISE

TRADE: MACHINIST

TOOLS AND MATERIALS: WORK BENCH, CENTER PUNCH, BALL PEEN HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ASSEMBLE PARTS #3 AND #4	1. REFER TO: IV-F-1(TS) STEP #1
2. ASSEMBLE PARTS #1 AND #3	1. SCREW VISE SCREW INTO STATIONARY JAW OF VISE
	2. TURN SCREW UNTIL END OF SCREW IS APPROXIMATELY 1 1/4" FROM OPPOSITE END OF VISE NOTE: CHECK FOR LOOSENESS OR BINDING IN SCREW AS IT IS TURNED
3. ASSEMBLE PARTS #2 AND #3	1. POSITION PART #3 ONTO BASE OF VISE WITH COVED SIDES FACING OUTWARD NOTE: POSITION 1/4" DRILLED HOLE TOWARD VISE SCREW
	2. TURN VISE SCREW UNTIL SCREW POSITIONS ITSELF FULLY INTO 1/4" HOLE ON MOVABLE JAW
	3. TIGHTEN VISE SCREW FIRMLY
4. INSERT PIN AND LOCK PARTS #2 AND #3	1. INSERT 1/16" PIN INTO 1/16" HOLE ON PART #2 AND TAP LIGHTLY WITH BALL PEEN HAMMER CAUTION: STRIKE PIN FIRMLY AND STRAIGHT. DO NOT BEND OR FORCE
	2. DRIVE PIN FLUSH WITH MOVABLE JAW
	3. CENTER PUNCH 4 PLACES AROUND HOLE TO PREVENT PIN FROM FALLING OUT

SKETCH: DRAWINGS #12 AND #12-A, TOOL MAKER'S VISE

REFERENCES: REF. #2, PP. 253-263

MACHINE SHOP CAST IRON GEAR

ENGINE LATHE 11

HORIZONTAL MILLING MACHINE 9

SHAPER 5

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, OPERATE DESIGNATED MACHINES, AND CONSTRUCT A CAST IRON GEAR ACCORDING TO SPECIFICATIONS.

CHECKING STANDARDS

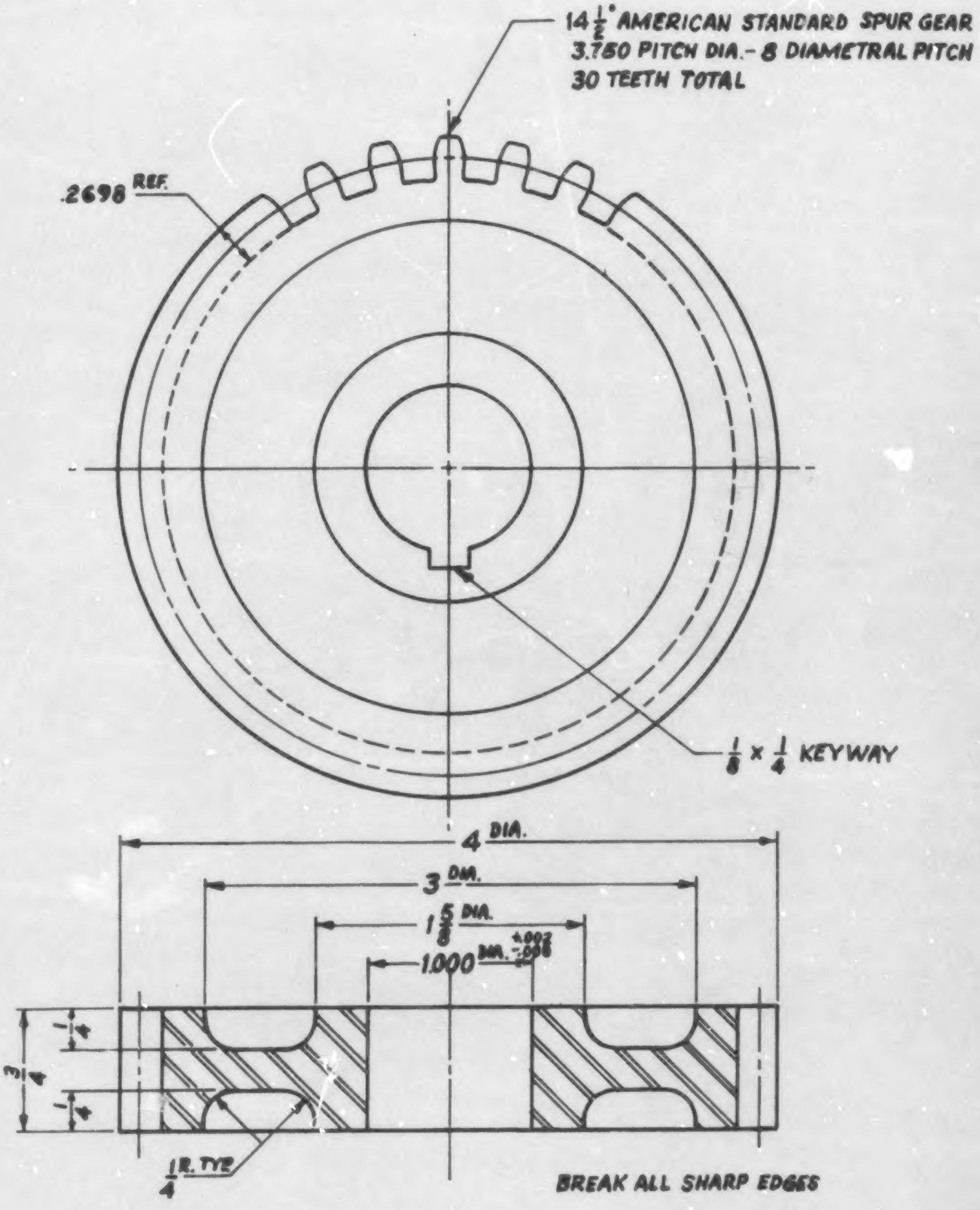
1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
2. HOLD ALL SURFACES TO PRECISION FINISH.
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT.
5. MAINTAIN A SAFETY ATTITUDE.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A, AND MCCARTHY, WILLARD J., METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.


14 1/2° AMERICAN STANDARD SPUR GEAR
3.750 PITCH DIA.- 8 DIAMETRAL PITCH
30 TEETH TOTAL
.2698 REF.
1/8 × 1/4 KEYWAY
4 DIA.
3 DIA.
1 5/8 DIA.
1.000 DIA. +.002 -.000
1/4
3/4
1/4
1/4 R. TYP.

BREAK ALL SHARP EDGES

F.A.Q.

DRAWING NO. 13	SPUR GEAR	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 11 MILLING JOB NO. 5 SHAPER JOB NO. 9	MATERIAL: CAST IRON FINISH: MACHINE SCALE: FULL	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-L-1(J)

JOB SHEET
ON
ENGINE LATHE

JOB: CAST IRON GEAR

MATERIALS: CAST IRON GEAR BLANK

TOOLS AND EQUIPMENT: ENGINE LATHE, DIAL INDICATOR, INDEPENDENT CHUCK, FACE PLATE, DRIVE DOG, LIVE AND DEAD CENTER, DRILL CHUCK AND KEY, FACING TOOL, TURNING TOOL, 23/64 " DRILL, 1" REAMER, 1" MANDREL, MILL FILE, 4" - 5" MICROMETER, 6" RULE, 1/4" SPHERICAL FORMING TOOL, 0-1" MICROMETER, DEPTH MICROMETER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #1, PP. 36-1 TO 36-44 AND REFERENCE #3, PP. 135-208. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS: OBTAIN GEAR BLANK FROM INSTRUCTOR

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-L-1(TS)	MOUNT GEAR BLANK IN FOUR-JAW CHUCK AND TRUE WORKPIECE
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL WORKPIECE
VII-D-1(TS)	SET UP AND DRILL 63/64" HOLE
VII-G-1a(TS)	SET UP AND REAM 1" HOLE
VII-L-1a(TS)	MOUNT GEAR BLANK ON MANDREL
VII-L-1b(TS)	SET UP, TURN GEAR BLANK AND WEBS ON MANDREL
VII-A-1c(TS)	CLEAN MACHINE
	ROUTE TO HORIZONTAL MILLING MACHINE

CHECK POINTS: STUDENTS TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUPS.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

TASK: MOUNT GEAR BLANK IN FOUR-JAW CHUCK AND TRUE WORKPIECE

JOB: CAST IRON GEAR

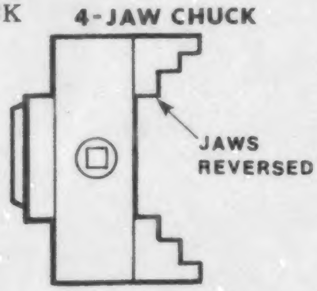
TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, INDEPENDENT CHUCK, CHALK OR PENCIL, CHUCK WRENCH, CAST IRON GEAR BLANK

TASK BREAKDOWN:

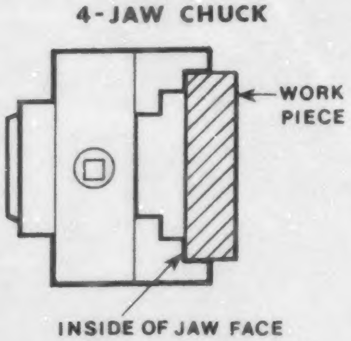
STEPS — KEY POINTS

1. MOUNT FOUR-JAW CHUCK



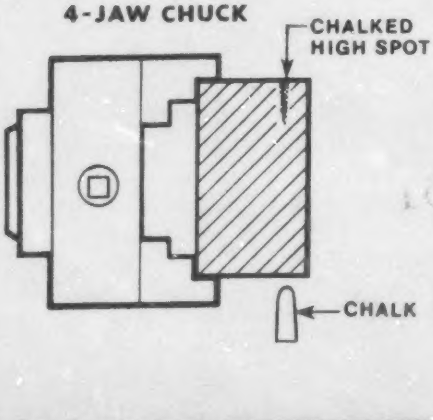
1. CLEAN SPINDLE
2. CLEAN INTERIOR OF CHUCK
   NOTE: SPINDLE MAY BE THREADED CAMLOCK TYPE D-1, OR TYPE L WITH LOCK RING AND KEY
3. PLACE CHUCK ON CRADLE BLOCK
4. MOVE INTO POSITION TO MOUNT CHUCK
5. MOUNT CHUCK AND LOCK
6. REVERSE JAWS OF CHUCK AS PER DRAWING

2. SET UP WORKPIECE



1. OPEN CHUCK JAWS SLIGHTLY LARGER THAN WORKPIECE
   NOTE: USE CONCENTRIC RINGS ON FACE OF CHUCK AS GUIDE
2. SET WORKPIECE IN CHUCK
3. SNUG EACH JAW AGAINST WORKPIECE
   NOTE: BE CAREFUL NOT TO OVER TIGHTEN ONE JAW
   NOTE: CHECK TO INSURE INSIDE FACE OF WORKPIECE IS PLACED AGAINST INSIDE FACE OF CHUCK JAWS AS PER DRAWING

3. TRUE UP WORKPIECE



1. ROTATE WORKPIECE
   NOTE: MACHINE MAY BE ROTATED BY HAND (SPINDLE IN NEUTRAL) OR BY SETTING SPEED AT SLOW SPEED
2. HOLD CHALK OR PENCIL LIGHTLY AGAINST WORKPIECE
   NOTE: CHALK MAY BE SUPPORTED BY TOOL POST
3. MARK HIGH SPOTS ON WORKPIECE

	NOTE: SHOULD CHALK MARK BE CONTINUED EVENLY AROUND WORKPIECE, THE WORK IS TRUE. SHOULD MARK BE ONLY IN ONE PLACE, LOOSEN JAW OPPOSITE MARK AND TIGHTEN JAW NEXT TO MARK. SEE ILLUSTRATION 4. CONTINUE ADJUSTMENT UNTIL WORKPIECE RUNS TRUE OR MARK IS CONTINUED AROUND WORKPIECE NOTE: ACCURACY BY THIS METHOD CAN BE OBTAINED TO LESS THAN .015". FOR GREATER ACCURACY THE SURFACE GAGE OR DIAL INDICATOR MAY BE USED
4. TIGHTEN WORKPIECE	1. TIGHTEN EACH JAW FIRMLY NOTE: TIGHTEN EACH JAW GRADUALLY TO PREVENT MOVING WORKPIECE OUT OF TRUENESS CAUTION: DO NOT LEAVE WORKPIECE LOOSE, AS IT MAY BE THROWN OUT WHILE WORKPIECE IS BEING MACHINED 2. INSPECT TO ASSURE TRUENESS OF WORKPIECE

SKETCH: DRAWING #13, CAST IRON GEAR

REFERENCES: REF. #1, PP. 36-21 TO 36-22
REF. #2, PP. 164 TO 166

TASK SHEET

VII-L-1a(TS)

TASK: MOUNT GEAR BLANK ON MANDREL

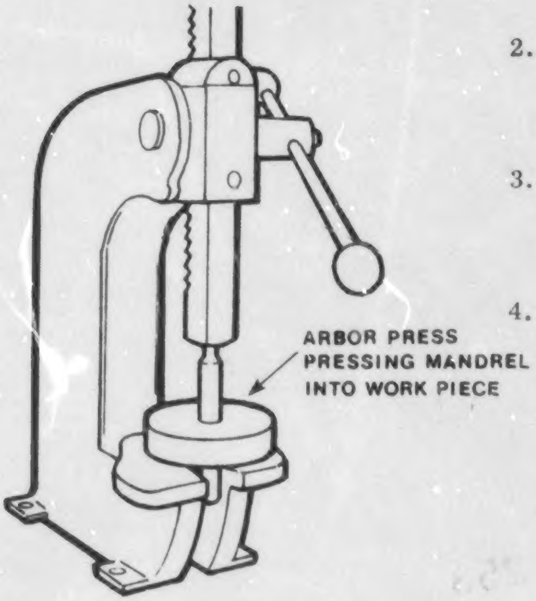
JOB: CAST IRON GEAR

TRADE: MACHINIST

TOOLS AND MATERIALS: GEAR BLANK, ARBOR PRESS, LUBRICATION OIL, COMBINATION SQUARE, 1" STANDARD SOLID MANDREL, GRAPHITE GREASE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECTION OF MANDREL	1. 1" STANDARD SOLID MANDREL NOTE: THIS WILL PLACE GEAR BLANK NEAR CENTER OF MANDREL 2. WIPE MANDREL CLEAN 3. APPLY THIN FILM OF OIL ON DIAMETER
2. PREPARATION OF WORKPIECE	1. CLEAN BORED HOLE 2. REMOVE BURRS FROM HOLE EDGES 3. APPLY GRAPHITE GREASE TO HOLE
3. PRESS GEAR BLANK ONTO MANDREL	1. PLACE WORKPIECE ON ARBOR PRESS TABLE NOTE: POSITION MACHINED SURFACE DOWN SO HOLE IS AT A RIGHT ANGLE 2. POSITION SMALL END OF MANDREL INTO WORKPIECE HOLE NOTE: LARGE END OF MANDREL HAS THE SIZE STAMPED ON IT 3. LOWER ARBOR UNTIL CONTACT IS MADE WITH MANDREL NOTE: ALIGN MANDREL PERPENDICULAR TO GEAR 4. PRESS MANDREL FIRMLY INTO THE WORKPIECE NOTE: AFTER STARTING TO PRESS MANDREL IN, CHECK WITH COMBINATION SQUARE TO INSURE SQUARENESS CAUTION: DO NOT APPLY TOO GREAT PRESSURE AS MANDREL WILL CAUSE HOLE TO OVERSIZE OR CAUSE MANDREL TO BEND



4. INSPECT SQUARENESS	1. REMOVE FROM ARBOR PRESS 2. INSPECT WITH SQUARE FOR PERPENDICULARITY 3. ROUTE TO ENGINE LATHE

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 36-38 TO 36-39
REF. #2, PP. 195-196

TASK SHEET VII-L-1b(TS)

TASK: SET UP, TURN GEAR BLANK, AND WEBS ON MANDREL

JOB: CAST IRON GEAR

TRADE: MACHINIST

TOOLS AND EQUIPMENT: ENGINE LATHE, FACE PLATE, LIVE AND DEAD CENTER, 1" MANDREL, 1/4" SPHERICAL RADIUS TOOL, 6" RULE, 4" MICROMETER, 0-1" MICROMETER, DEPTH MICROMETER, 1/4" RADIUS GAGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK BETWEEN CENTERS	REFER TO: VII-B-1d(TS) NOTE: MACHINED FACE OF GEAR IS DIRECTED TOWARD TAILSTOCK
2. TURN GEAR DIAMETER TO 4.000"	1. REFER TO: VII-B-1e(TS) NOTE: FEED DIRECTION MUST BE TOWARD HEADSTOCK TO PREVENT WORKPIECE FROM BECOMING LOOSE ON MANDREL CAUTION: TAKE LIGHT CUTS TO PREVVENT WORKPIECE FROM SLIPPING OR CHATTERING 2. REMOVE TURNING TOOL
3. TURN WEB OF GEAR	1. SET UP 1/4" SPHERICAL RADIUS TOOL NOTE: POSITION CUTTING PERPENDICULAR TO FACE OF GEAR BLANK 2. SET SPINDLE SPEED NOTE: SPEED SHOULD BE SET TO PREVENT TEARING OF WORKPIECE DUE TO TOO HIGH SPEED 3. FEED TOOL BY HAND INTO FACE OF WORKPIECE NOTE: HOLD 3" REFERENCE DIAMETER ON OUTSIDE EDGE OF WEB (1/2" FROM OUTSIDE EDGE OF GEAR) 4. TAKE LIGHT CUTS FEEDING TOOL TOWARD HUB OF GEAR NOTE: HOLD 1 5/8" DIAMETER AS SPECIFIED ON DRAWING FOR HUB

	5. CONTINUE LIGHT CUTS UNTIL 1/4" WEB DEPTH IS OBTAINED 6. CHECK RADII WITH RADIUS GAGE 7. BREAK EDGES AND REMOVE FROM MACHINE
4. REMOVE GEAR BLANK FROM MANDREL	1. POSITION MANDREL AND GEAR BLANK ON ARBOR PRESS NOTE: SMALL END OF MANDREL WILL BE POSITIONED UPWARD WITH LARGE END POSITIONED DOWNWARD BETWEEN SLOTS IN ARBOR PRESS BASE PLATE 2. PRESS MANDREL OUT OF GEAR BLANK HOLE CAUTION: DO NOT PERMIT MANDREL TO DROP ON FLOOR
5. REMOUNT GEAR BLANK ON MANDREL	1. TURN GEAR BLANK AROUND NOTE: MACHINED FACE WILL BE POSITIONED TOWARD LARGE END OF MANDREL 2. PRESS MANDREL INTO GEAR BLANK HOLE REFER TO: VII-L-1a(TS)
6. MOUNT WORK BETWEEN CENTERS	REFER TO: VII-B-1d(TS) NOTE: MACHINED FACE IS POSITIONED TOWARD HEADSTOCK
7. FACE AND TURN WEB	1. SET UP MACHINE AS IN STEP #1 NOTE: DO NOT PERMIT POINT OF FACING TOOL TO TOUCH HARDENED MANDREL 2. FACE GEAR BLANK NOTE: HOLD 3/4" GEAR WIDTH AS PER DRAWING 3. WITH FACING TOOL, SCORE REFERENCE DIAMETERS FOR GEAR WEB 4. TURN WEB AS PER STEP #3 5. BURR AND REMOVE FOR MACHINE 6. ROUTE TO MILLING MACHINE

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 36-38 TO 36-39
REF. #2, PP. 195-196

IX-I-1(J)

JOB SHEET
ON
HORIZONTAL MILLING MACHINE

JOB: CAST IRON GEAR

MATERIALS: GEAR BLANK AS MACHINED ON LATHE

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, 8 DIAMETRAL PITCH NO. 3 1/2 INVOLUTE GEAR CUTTER, ARBOR AND SPACING COLLARS, DIVIDING HEAD, INDEX PLATE, FOOTSTOCK, LATHE DOG, CENTER FOR DIVIDING HEAD, COMBINATION SQUARE, DEPTH MICROMETER, GAGE BLOCKS, 6" RULE, GEAR TOOTH VERNIER CALIPER, FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, MILLING MACHINE, PP. 38-1 TO 38-38; AND REF. #3, MILLING MACHINE, PP. 229-285 CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-A-1a(TS)	SET UP GEAR CUTTER AND SET MACHINE FOR SPEED AND FEED
IX-I-1(TS)	SET UP DIVIDING HEAD AND FOOTSTOCK
IX-I-1a(TS)	MOUNT WORK BETWEEN CENTERS ON DIVIDING HEAD
IX-I-1b(TS)	SET UP INDEX PLATE
IX-I-1c(TS)	MACHINE 30 TOOTH GEAR
	ROUTE TO SHAPER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITIONS
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET IX-I-1(TS)

TASK: SET UP AND ALIGN DIVIDING HEAD AND FOOTSTOCK

JOB: CAST IRON GEAR

TRADE: MACHINIST

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, DIVIDING HEAD, FOOTSTOCK, DIVIDING HEAD CENTER, TEST BAR, DIAL INDICATOR, AND NECESSARY WRENCHES

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PLACE DIVIDING HEAD ON MILL TABLE	1. WIPE MILLING MACHINE TABLE CLEAN 2. WIPE BOTTOM OF DIVIDING HEAD BASE CLEAN 3. SET UP DIVIDING HEAD ON MILL TABLE NOTE: POSITION SO INDEX CRANK FACES OPERATOR 4. POSITION T-BOLTS IN T-SLOTS ON MILL TABLE AND SLIDE T-BOLTS IN HOLDING SLOT ON DIVIDING HEAD BASE 5. FASTEN DIVIDING HEAD BASE TO TABLE NOTE: DO NOT TIGHTEN T-BOLTS, JUST SNUG
2. SET UP DIVIDING HEAD CENTER AND DRIVE DOG	1. REMOVE UNIVERSAL CHUCK FROM DIVIDING HEAD NOTE: CHUCK MAY NOT BE ON. FOLLOW PROCEDURE FOR REMOVING CHUCK FROM LATHE SPINDLE 2. WIPE DIVIDING HEAD SPINDLE CLEAN 3. WIPE DIVIDING HEAD CENTER CLEAN AND APPLY A LIGHT FILM OF OIL ON CENTER 4. INSERT CENTER INTO SPINDLE HOLE NOTE: MILLING MACHINE DOG IS ATTACHED TO CENTER CAUTION: DO NOT DROP OR DAMAGE POINT OF CENTER
3. SET UP FOOTSTOCK	1. WIPE BASE OF FOOTSTOCK CLEAN 2. SET UP FOOTSTOCK ON MILL TABLE NOTE: FOOTSTOCK CENTER WILL FACE DIVIDING HEAD

3. MOVE FOOTSTOCK UP TO DIVIDING HEAD
   NOTE: MAINTAIN DISTANCE BETWEEN LENGTH OF TEST BAR AND MANDREL
4. FASTEN FOOTSTOCK TO TABLE WITH T-BOLTS
   NOTE: SNUG BOLTS BUT DO NOT TIGHTEN

4. ALIGN DIVIDING HEAD AND FOOTSTOCK

1. PLACE TEST BAR BETWEEN CENTERS
   NOTE: SNUG TEST BAR BY ADJUSTING THE LONGITUDINAL ADJUSTING KNOB ON FOOTSTOCK
2. ATTACH DIAL INDICATOR TO MACHINE COLUMN
3. INDICATE BOTH THE TOP AND SIDE OF TEST BAR FOR ALIGNMENT
   NOTE: PROCEDURE IS THE SAME AS FOR INDICATING A VISE
4. MAKE ANY ADJUSTMENTS NECESSARY TO ALIGN TEST BAR
5. TIGHTEN T-BOLTS ON DIVIDING HEAD AND FOOTSTOCK
6. RECHECK ALIGNMENT
7. LOOSEN FOOTSTOCK SPINDLE AND REMOVE TEST BAR

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 38-20 TO 38-21
REF. #3, PP. 256-258

TASK SHEET IX-I-1a(TS)

TASK: MOUNT WORK BETWEEN CENTERS ON DIVIDING HEAD

JOB: CAST IRON GEAR

TRADE: MACHINIST

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, DIVIDING HEAD WITH FOOTSTOCK, DIAL INDICATOR, WRENCH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN DIVIDING HEAD AND FOOTSTOCK CENTERS	1. WIPE CENTERS CLEAN 2. INSPECT FOR BURRS 3. WIPE LIGHTLY COAT OF OIL ON CENTER POINTS
2. MOUNT LATHE DOG ON MANDREL	1. PLACE LATHE DOG ON MANDREL NOTE: TAIL POINTS TOWARD MILLING MACHINE DOG SLOT 2. POSITION LATHE DOG SO TAIL FITS INTO SLOT OF MILLING MACHINE DOG CAUTION: DO NOT PERMIT TAIL OF LATHE DOG TO BIND 3. TIGHTEN SET SCREW ON LATHE DOG 4. TIGHTEN SET SCREW ON MILLING MACHINE DOG NOTE: THIS PROTECTS AGAINST BACKLASH
3. INSTALL WORKPIECE	1. CLEAN CENTER DRILLED HOLES ON MANDREL 2. PLACE LARGE END OF MANDREL ON CENTER OF DIVIDING HEAD 3. PLACE SMALL END OF MANDREL ON FOOTSTOCK CENTER 4. ADJUST FOOTSTOCK CENTER ADJUSTING NUT UNTIL TIGHT TENSION IS PLACED ON CENTERS
4. INDICATE WORKPIECE SETUP	1. REFER TO: IX-I-1(TS), STEP 4 2. CHECK FACE OF GEAR BLANK NOTE: MOVE INDICATOR VERTICALLY UP AND DOWN FACE OF GEAR BY RAISING AND LOWERING TABLE 3. REMOVE DIAL INDICATOR

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 38-21 TO 38-22
REF. #3, PP. 256 TO 258

TASK SHEET

IX-I-1b(TS)

TASK:	SET UP INDEX PLATE
JOB:	CAST IRON GEAR
TRADE:	MACHINIST
TOOLS AND EQUIPMENT:	DIVIDING HEAD, 15 HOLE INDEX PLATE, WRENCH, SCREWDRIVER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE INDEX PLATE	1. REMOVE NUT ON INDEX WORM SHAFT
	2. REMOVE INDEX CRANK
	3. REMOVE SECTOR ARMS NOTE: MAINTAIN POSITION AND ORDER OF REMOVAL AS EACH PART IS REMOVED
	4. REMOVE INDEX PLATE NOTE: INDEX PLATE WILL EITHER BE REMOVED OR TURNED AROUND TO OBTAIN CORRECT HOLE CIRCLE
2. REPLACE CORRECT INDEX PLATE	1. SELECT CORRECT INDEX PLATE. REFER TO: REF. #1, P. 38-21 OR REF. #2, P. 257
	2. REPLACE SECTOR ARMS CAUTION: DO NOT DAMAGE BRASS SPACER BETWEEN SECTOR ARMS
	3. REPLACE INDEX CRANK NOTE: POSITION INDEX CRANK ON SLOT SO INDEX PIN WILL LOCATE IN CORRECT HOLE CIRCLE ON INDEX PLATE, IN THIS CASE THE 15 HOLE CIRCLE ON THE BROWN AND SHARPE INDEX PLATE
	4. REPLACE NUT ON WORM SHAFT AND TIGHTEN
	5. TURN CRANK TO INSPECT FOR FREE MOVEMENT
3. SET SECTOR ARMS FOR 30 TOOTH INDEXING	1. LOOSEN SET SCREW ON SECTOR ARMS NOTE: USUALLY A BRASS SCREW WITH A SCREWDRIVER SLOT
	2. PLACE BEVELED EDGE OF LEFT SECTOR ARM AGAINST INDEX PIN NOTE: THIS WILL PLACE SECTOR ARM ON LEFT HAND SIDE OF INDEX PIN

3. COUNT 5 HOLES TO THE RIGHT OF INDEX PIN
   NOTE: DO NOT COUNT HOLE THE INDEX PIN IS IN
4. MOVE RIGHT SECTOR ARM SLIGHTLY PAST 5TH HOLE
   NOTE: THIS WILL POSITION SECTOR ARM ON RIGHT HAND SIDE OF INDEX PIN WHEN PIN IS IN POSITION
5. TIGHTEN SECTOR ARM SET SCREW
6. INSPECT BOTH SECTOR ARM AND INDEX CRANK FOR CORRECT MOVEMENT

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 38-20 TO 38-21
REF. #3, PP. 256-258

TASK SHEET IX-I-1c(TS)

TASK: MACHINE 30 TOOTH GEAR

JOB: CAST IRON GEAR

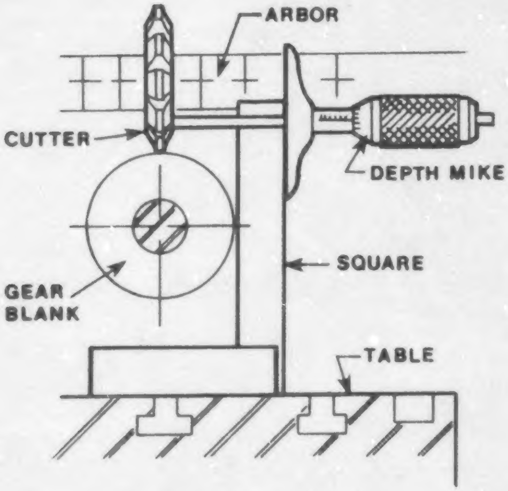
TRADE: MACHINIST

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, ARBOR, SPACING COLLAR, 8 DIMETRAL PITCH #3 1/2 INVOLUTE GEAR CUTTER, DIVIDING HEAD, 6" RULE, COMBINATION SQUARE, GAGE BLOCKS, AND DEPTH MICROMETER

TASK BREAKDOWN:

STEPS — KEY POINTS

1. CENTER GEAR CUTTER



CENTER GEAR CUTTER

   1. POSITION GEAR CUTTER OVER THE APPROXIMATE CENTER OF GEAR BLANK
   2. LOWER GEAR CUTTER UNTIL CUTTER IS ABOUT 1/4" FROM GEAR
   3. PLACE HEAD OF COMBINATION SQUARE ON MILL TABLE WITH BLADE EDGE AGAINST SIDE OF GEAR BLANK. SEE ILLUSTRATION
   4. MEASURE DISTANCE FROM BLADE OF SQUARE TO SIDE OF CUTTER
   5. REPEAT PROCEDURE ON OTHER SIDE OF GEAR
      NOTE: THIS MAY BE DONE WITH RULER, DEPTH MICROMETER, OR GAGE BLOCKS
   6. ADJUST MILL TABLE UNTIL DISTANCE FROM BOTH SIDES OF GEAR BLANK TO THE SIDES OF CUTTER ARE THE SAME
      NOTE: THE GAGE BLOCK OR DEPTH MICROMETER IS MORE PRECISION
   7. LOCK CROSS SLIDE

2. POSITION CUTTER FOR ROUGH CUT

   1. CUT MACHINE ON
      NOTE: OBSERVE CUTTER ROTATION. THE CUTTER SHOULD BE FEEDING INTO SIDE OF GEAR, THAT IS, CONVENTIONAL MILLING
   2. RAISE TABLE UNTIL CUTTER JUST TOUCHES WORKPIECE
      NOTE: THIS MAY BE DONE BY PLACING A PIECE OF PAPER BETWEEN CUTTER AND GEAR BLANK

	3. SET GRADUATED FEED COLLAR ON VERTICAL FEED TO ZERO
3. SET FRONT STOP	1. MOVE LONGITUDINAL FEED UNTIL WORKPIECE CLEARS CUTTER 2. LOOSEN STOP ON SIDE OF TABLE 3. SLIDE STOP TO STARTING POSITION 4. TIGHTEN STOP
4. SET AUTOMATIC FEED TRIP DOG	1. TURN LONGITUDINAL FEED HAND UNTIL CUTTER HAS COMPLETELY CLEARED OPPOSITE SIDE OF WORKPIECE NOTE: THIS SETTING MAY BE DONE AT COMPLETION OF FIRST CUT 2. LOOSEN AUTOMATIC FEED TRIP DOG AND POSITION IT AT END OF CUT 3. TIGHTEN TRIP DOG 4. REPOSITION WORKPIECE AT THE STARTING POINT NOTE: BEGINNING STOP DOG
5. ROUGH CUT 1ST GEAR TOOTH	1. POSITION CUTTER AT STARTING POINT NOTE: CLEAR CUTTER FROM WORKPIECE 2. RAISE TABLE ABOUT 2/3 DEPTH OF TOOTH. APPROXIMATELY .200" 3. LOCK VERTICAL KNEE CLAMP NOTE: REMAINS LOCKED UNTIL ALL TEETH HAVE BEEN CUT AT THIS SETTING 4. HAND FEED UNTIL CUTTER ENGAGES WORK 5. ENGAGE AUTOMATIC FEED 6. CUT FIRST TOOTH NOTE: AUTOMATIC FEED TRIP DOG WILL CUT OFF FEED UPON COMPLETION OF CUT
6. INDEX GEAR FOR SECOND TOOTH	1. ROTATE SECTOR ARMS CLOCKWISE UNTIL LEFT HAND SECTOR ARM MAKES CONTACT WITH CRANK PIN 2. PULL INDEX CRANK PIN OUT 3. TURN CRANK ONE COMPLETE REVOLUTION CAUTION: DO NOT RELEASE CRANK PIN AS THIS MAY CHANGE POSITION OF SECTOR ARMS

	4. TURN CRANK AN ADDITIONAL FIVE HOLES NOTE: 5TH HOLE WILL BE ON THE LEFT HAND SIDE OF RIGHT SECTOR ARM 5. RELEASE CRANK PIN INTO HOLE NOTE: THIS PROCEDURE IS BASED ON USE OF BROWN AND SHARPE 15 HOLE CIRCLE INDEX PLATE 6. CUT SECOND TOOTH AS PER STEP 5 CAUTION: DO NOT CHANGE HEIGHT OF TABLE
7. COMPLETE ROUGH CUTTING OF GEAR TEETH	FOLLOW STEPS FOR INDEXING AND CUTTING GEAR TEETH AS IN STEPS 5 AND 6 NOTE: TABLE SETTING REMAINS THE SAME FOR ALL TEETH CAUTION: CUT MACHINE OFF BEFORE INDEXING TO INSURE AGAINST DAMAGING TEETH ON GEAR
8. SECOND ROUGH CUT	1. LOOSEN VERTICAL FEED LOCK ON TABLE 2. RAISE TABLE .059" NOTE: CHECK DIAL ON ELEVATING HANDLE 3. FOLLOW SAME PROCEDURE AS IN STEPS 5 THRU 6 CAUTION: CHECK CAREFULLY TO INSURE AGAINST MOVING INDEX SECTOR ARMS OUT OF POSITION
9. FINISH CUT GEAR TEETH	1. CHECK DEPTH OF TOOTH NOTE: MEASURING WITH GEAR TOOTH VERNIER CALIPER IS THE MOST ACCURATE METHOD NOTE: TOOTH DEPTH SHOULD BE .0108" OVERSIZE 2. RAISE TABLE .010" 3. LOCK TABLE 4. FINISH CUT ALL TEETH AS PER ROUGH CUTTING GEAR TEETH NOTE: CUT FIRST TOOTH AND INSPECT FOR ACCURACY BEFORE CONTINUING TO THE OTHER TEETH. MAKE ANY NECESSARY ADJUSTMENTS 5. CUT THE REMAINDER OF TEETH TO FINISHED SIZE

10. REMOVE GEAR	1. LOOSEN FOOTSTOCK SPINDLE 2. REMOVE MANDREL FROM BETWEEN DIVIDING HEAD AND FOOTSTOCK CAUTION: DO NOT DROP OR BUMP GEAR AGAINST MACHINE 3. REMOVE GEAR FROM MANDREL. REFER TO: VII-L-1a(TS) STEP 3 4. BURR TEETH WITH FILE CAUTION: HANDLE CAREFULLY TO AVOID SHARP EDGES
11. CLEAN MACHINE	REFER TO: IX-A-1c(TS) ROUTE TO SHAPER

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 38-20 TO 38-21
REF. #3, PP. 270-274

VIII-C-1(J)

JOB SHEET
ON
SHAPER

JOB: CAST IRON GEAR

MATERIALS: GEAR AS MACHINED ON LATHE AND MILLING MACHINE

TOOLS AND EQUIPMENT: SHAPER, 3/4" EXTENSION BAR AND TOOL HOLDER, 1/4" ROUGH CUTTING KEYWAY TOOL BIT, 1/4" FINISHING TOOL BIT, 6" RULE, SHAPER VISE, DIAL INDICATOR, CENTER HEAD, SQUARE, SCRIBER, SOFT FACE MALLET, PARALLELS, MILL FILE, AND NECESSARY WRENCHES FOR NUTS ON MACHINE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #1, PLANING MACHINES, PP. 37-1 TO 37-16; REF. #3, PLANING MACHINES, PP. 209-227. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

VIII-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VIII-C-1(TS)	ALIGN SHAPER VISE
VIII-C-1a(TS)	SET UP GEAR FOR CUTTING INTERNAL KEYWAY
VIII-C-1b(TS)	SET UP 3/4" EXTENSION BAR AND TOOL
VIII-C-1c(TS)	SET UP AND CUT INTERNAL KEYWAY
VIII-A-1e(TS)	CLEAN MACHINE
	HAVE INSPECTED BY INSTRUCTOR

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VIII-C-1 (TS)

TASK: ALIGN SHAPER VISE

JOB: CAST IRON GEAR

TRADE: MACHINIST

TOOLS AND MATERIALS: UNIVERSAL SHAPER VISE, DIAL INDICATOR, NECESSARY WRENCHES FOR CLAMPING NUTS, SHAPER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP VISE	1. CLEAN SHAPER TABLE NOTE: CLEAN T-SLOTS OF SHAVINGS 2. CLEAN BOTTOM OF VISE BASE 3. PLACE VISE ON TOP OF TABLE NOTE: T-BOLTS ARE LOOSENED TO PERMIT FREE MOVEMENT OF BOLTS TO SLIDE IN T-SLOT CAUTION: DO NOT DROP VISE OR GET FINGERS CAUGHT BETWEEN TABLE AND VISE 4. TIGHTEN NUTS ON HOLD DOWN T-BOLTS
2. SWIVEL VISE JAWS	1. LOOSEN NUTS ON TOP OF SWIVEL VISE NOTE: THIS PERMITS THE VISE TO SWIVEL ON THE BASE 2. SWIVEL VISE UNTIL JAWS ARE PERPENDICULAR TO STROKE OF RAM NOTE: REFERENCE MARK ON SWIVEL AND BASE WILL INDICATE ANGLE VISE IS SET AT 3. SNUG NUTS ON SWIVEL VISE NOTE: DO NOT TIGHTEN NUTS UNTIL FINAL ALIGNMENT IS MADE
3. ALIGN VISE JAWS	1. SET DIAL INDICATOR IN TOOL HOLDER 2. POSITION DIAL INDICATOR AGAINST SOLID JAW OF VISE 3. MOVE SHAPER RAM BY HAND UNTIL DIAL INDICATOR REGISTERS APPROXIMATELY ONE-HALF REVOLUTION 4. TURN INDICATOR DIAL TO ZERO 5. MOVE DIAL INDICATOR ALONG FACE OF SOLID JAW BY TURNING CROSS FEED

5. (CONT'D.)
SCREW MANUALLY
CAUTION: INSPECT JAW FOR CLEANLINESS AND DAMAGED SURFACE BEFORE INDICATING
6. OBSERVE READING ON DIAL INDICATOR

6. ADJUST VISE FOR ALIGNMENT

1. ADJUST VISE TO ONE-HALF DIAL INDICATOR READING
CAUTION: ALWAYS ADJUST AWAY FROM THE INDICATOR
NOTE: ADJUSTMENT MAY BE DONE WITH A LIGHT TAP ON THE VISE JAW WITH A SOFT FACE MALLET
2. ADJUST UNTIL READING ON DIAL INDICATOR REMAINS THE SAME AS INDICATOR IS MOVED ALONG FACE OF SOLID JAW
3. TIGHTEN CLAMPING NUT ON SWIVEL JAW
4. RECHECK FOR ACCURACY
5. ADJUST IF NECESSARY
6. REMOVE DIAL INDICATOR FROM MACHINE

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #3, PP. 210-212
REF. #1, PP. 37-1 TO 37-7

TASK SHEET VIII-C-1a(TS)

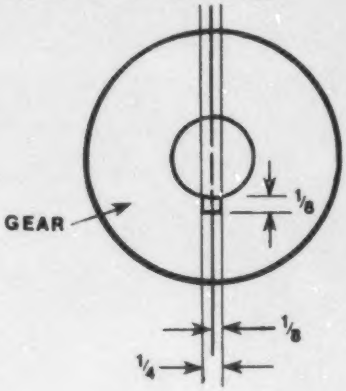
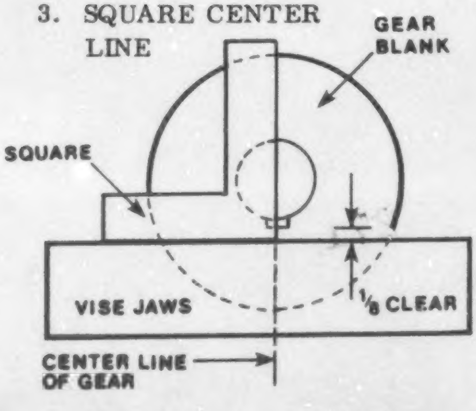
TASK: SET UP GEAR FOR CUTTING INTERNAL KEYWAY

JOB: CAST IRON GEAR

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, SQUARE, SCRIBE, LAYOUT INK, 6" RULE, PARALLELS, SOFT FACE MALLET

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAY OUT KEYWAY  	1. APPLY LAYOUT INK TO SIDE OF GEAR 2. LAY OUT CENTER LINE WITH CENTER HEAD 3. LAY OUT AND SCRIBE TWO LINES PARALLEL TO CENTER LINE AND 1/8" FROM CENTER LINE NOTE: THESE LINES REPRESENT THE WIDTH OF THE KEY SLOT. SEE SKETCH 4. LAY OUT AND SCRIBE 1/8" DEPTH OF KEYWAY NOTE: DEPTH IS MEASURED FROM SIDE OF KEYWAY RATHER THAN CENTER LINE
2. SET UP GEAR BLANK IN VISE	1. WIPE BOTTOM OF VISE CLEAN 2. PLACE PARALLELS ON BOTTOM OF VISE NOTE: HEIGHT OF PARALLEL SHOULD PERMIT SUFFICIENT CLEARANCE TO CUT KEYWAY APPROXIMATELY 3/16" FROM BOTTOM OF HOLE 3. PLACE GEAR BLANK ON PARALLELS 4. SNUG VISE JAWS NOTE: DO NOT TIGHTEN 5. CHECK TO INSURE BOTTOM OF KEYWAY CLEARS TOP OF VISE
3. SQUARE CENTER LINE  GEAR BLANK SQUARE VISE JAWS 1/8 CLEAR CENTER LINE OF GEAR	1. PLACE SQUARE ON TOP OF VISE JAW 2. SLIDE EDGE OF SQUARE UNTIL CENTER LINE OF GEAR AND SQUARE LINE UP. SEE ILLUSTRATION NOTE: CENTER LINE WILL BE PERPENDICULAR TO TOP OF VISE JAWS

3. SHOULD EDGE OF SQUARE AND CENTER LINE NOT LINE UP, TAP GEAR LIGHTLY WITH MALLET UNTIL ALIGNMENT IS MADE
4. TIGHTEN VISE
5. RECHECK CENTER LINE ALIGNMENT

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 37-1 TO 37-7
REF. #3, PP. 220-221

TASK SHEET VIII-C-1b(TS)

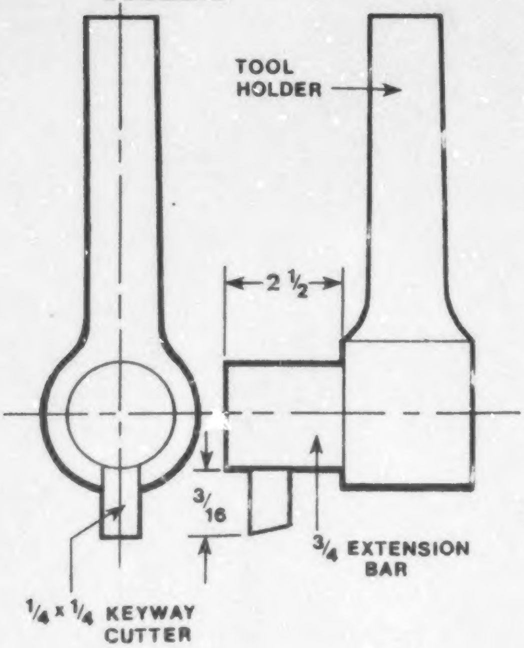
TASK: SET UP 3/4" EXTENSION BAR AND TOOL

JOB: CAST IRON GEAR

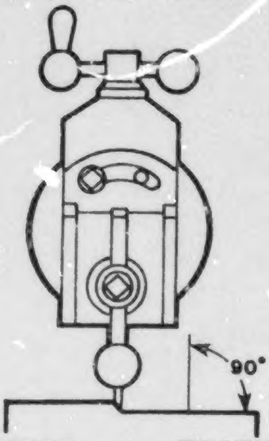
TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, 3/4" EXTENSION BAR, 1/4" HSS KEYWAY CUTTING TOOL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT AND PREPARE TOOLING  TOOL HOLDER 2 1/2 3/16 3/4 EXTENSION BAR 1/4 x 1/4 KEYWAY CUTTER	1. SELECT ROUGH CUTTING TOOL NOTE: TOOL SHOULD BE GROUND 1/32" LESS THAN FINISH SIZE OF KEYWAY 2. SELECT FINISH CUTTING TOOL NOTE: FOR VERY CLOSE TOLERANCE FIT, GRIND TOOL .002"-.003" UNDER SIZE 3. SELECT EXTENSION BAR NOTE: EXTENSION BAR SHOULD BE STURDY AND ADJUSTED TO SHORTEST POSSIBLE LENGTH. APPROXIMATELY 2" - 2 1/2" FROM HOLDER 4. PLACE KEYWAY CUTTING TOOL IN EXTENSION BAR. SEE ILLUSTRATION NOTE: TOOL SHOULD EXTEND OUT ONLY ENOUGH REQUIRED TO CUT KEYWAY AND MAINTAIN SAFE CLEARANCE. APPROXIMATELY 3/16" 5. ADJUST POSITION OF EXTENSION BAR IN HOLDER. SEE ILLUSTRATION NOTE: CUTTING TOOL MUST BE PARALLEL TO TOOL HOLDER
2. SET UP TOOL HOLDER IN TOOL POST	1. LOOSEN TOOL POST BOLT 2. PLACE EXTENSION BAR TOOL HOLDER INTO TOOL POST SLOT NOTE: KEEP DISTANCE BETWEEN TOOL POST AND EXTENSION BAR AS CLOSE AS POSSIBLE 3. TIGHTEN TOOL POST BOLT NOTE: TOOL MUST BE PERPENDICULAR TO TABLE

3. SET UP TOOL HEAD



1. CHECK SHAPER HEAD FOR ANGULAR POSITION
   NOTE: IF SHAPER HEAD IS NOT SET ON 90°, LOOSEN SHAPER HEAD LOCK NUTS AND SWIVEL TO 90° AND LOCK
2. SET TOOL HEAD APRON AT 90° ANGLE TO TABLE. SEE ILLUSTRATION
   NOTE: LOOSEN TWO LOCK NUTS ON FRONT OF CLAPPER BOX AND SWIVEL APRON
3. CHECK FOR SQUARENESS WITH TABLE AND VISE
4. TIGHTEN LOCK NUTS

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 37-5 TO 37-7
REF. #3, PP. 215, 216, 220

TASK SHEET VIII-C-1c(TS)

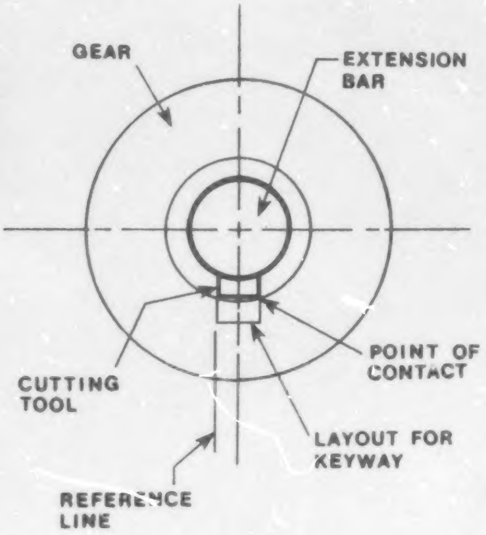
TASK: SET UP AND CUT INTERNAL KEYWAY

JOB: CAST IRON GEAR

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, 3/4" EXTENSION BAR, TOOL HOLDER, 1/4" ROUGHING TOOL, 1/4" FINISH TOOL, 6" RULE, MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CENTER TOOLING WITH KEYWAY LAYOUT  GEAR EXTENSION BAR POINT OF CONTACT CUTTING TOOL LAYOUT FOR KEYWAY REFERENCE LINE	1. MOVE SHAPER RAM BY HAND UNTIL EXTENSION BAR CLEARS BACK SIDE OF GEAR NOTE: ABOUT 1" CLEARANCE OR THE BACK POSITION OF RAM STROKE 2. TURN CROSS FEED SCREW UNTIL EXTENSION BAR IS CENTERED LONGITUDINALLY ON GEAR HOLE 3. LOWER TOOL HEAD UNTIL EXTENSION BAR AND CUTTER CLEAR GEAR HOLE 4. MOVE RAM FORWARD UNTIL CUTTER IS EVEN WITH FRONT EDGE OF GEAR 5. POSITION CUTTING TOOL SO ONE EDGE OF TOOL IS DIRECTLY OVER ONE EDGE OF KEYWAY LAYOUT. SEE ILLUSTRATION NOTE: ALIGNMENT MAY BE CHECKED WITH A SQUARE AS PER VIII-C-1a(TS) STEP 3 6. LOWER TOOL HEAD UNTIL CUTTING TOOL MAKES CONTACT WITH GEAR HOLE NOTE: EDGES OF TOOL AND KEYWAY SHOULD LINE UP
2. ROUGH CUT KEYWAY	1. SET SHAPER SPEED NOTE: APPROXIMATELY 60 SFM 2. MOVE RAM BY HAND THROUGH COMPLETE STROKE TO INSURE CORRECT SETUP 3. LOCK TABLE 4. LOCK CROSS FEED

	5. TAKE TRIAL CUT NOTE: FEED DOWN ONLY UNTIL TOOL CUTS FULL WIDTH OF TOOL 6. INSPECT POSITION OF TOOL WITH KEYWAY LAYOUT 7. SET GRADUATED DIAL ON DOWN FEED SCREW OF TOOL HEAD TO ZERO 8. FEED TOOL DOWNWARD HOLDING .125" DEPTH OF KEYWAY NOTE: FEED DOWNWARD .003" TO .006" AT THE END OF EACH STROKE 9. REMOVE ROUGH CUTTING TOOL BIT 10. INSPECT SIZE OF KEYWAY
3. FINISH CUT KEYWAY	1. SET UP FINISH TOOL BIT AS PER VIII-C 1b(TS), STEP 1 2. MOVE TABLE IN DIRECTION NECESSARY TO MACHINE KEYWAY TO SIZE NOTE: HOLD .250" WIDTH 3. INSPECT KEYWAY FOR FINISHED SIZE 4. REMOVE GEAR FROM VISE 5. BURR KEYWAY EDGES WITH FILE
4. CLEAN MACHINE	AS PER VIII-A-1e(TS)

SKETCHES: DRAWING #13: CAST IRON GEAR

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #3, PP. 209 TO 227

MACHINE SHOP TAPER RING GAGE

ENGINE LATHE 12

HORIZONTAL MILLING MACHINE 10

BENCH 8

HEAT TREAT 5

SURFACE GRINDER 1

INTERNAL GRINDER 1

TOOL POST GRINDER-ALTERNATE METHOD 1

TOOL AND CUTTER GRINDER-ALTERNATE METHOD 1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWING, OPERATE DESIGNATED MACHINES, AND CONSTRUCT A TAPER RING GAUGE ACCORDING TO SPECIFICATIONS.

CHECKING STANDARDS

1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
2. HOLD ALL SURFACES TO PRECISION FINISH.
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT.
5. MAINTAIN A SAFETY ATTITUDE.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

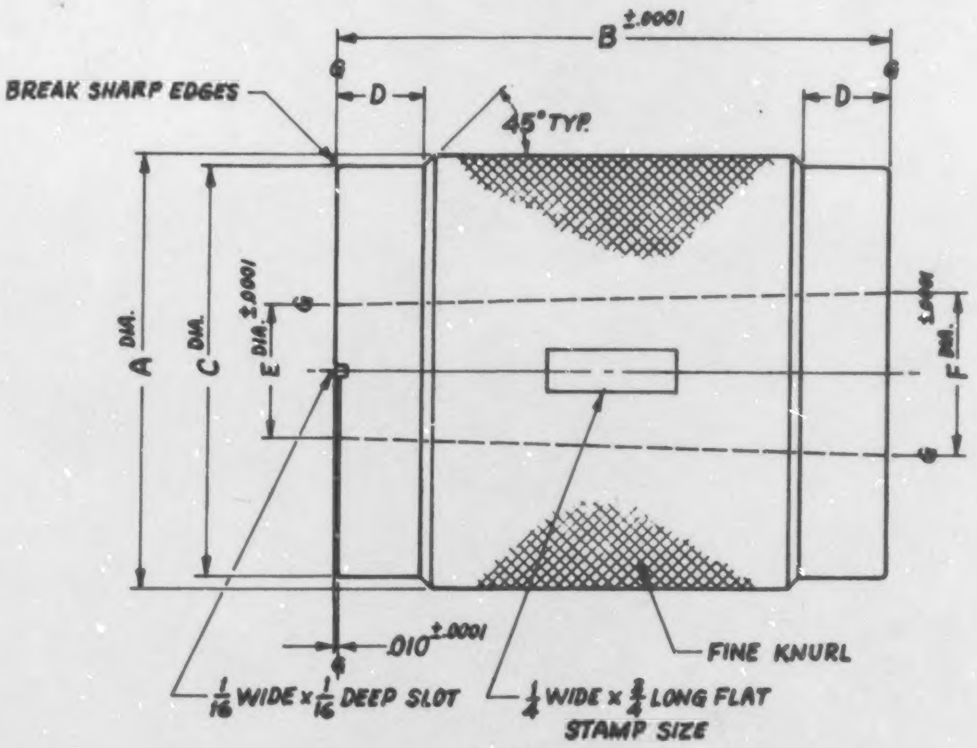
REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

REF. #4, MCCARTHY, WILLARD J. AND SMITH, ROBERT E., MACHINE TOOL TECHNOLOGY.

REF. #5, KRAR, S. F., OSWALD, J. W. AND ST. AMAND, J. E., TECHNOLOGY OF MACHINE TOOLS.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #4 ON DRAWING #14. IF OTHER SIZES OR LENGTHS ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.


B ±.0001
D
D
BREAK SHARP EDGES
45° TYP.
A DIA.
C DIA.
E DIA. ±.0001
F DIA. ±.0001
.010 ±.0001
FINE KNURL
$\frac{1}{16}$ WIDE × $\frac{1}{16}$ DEEP SLOT
$\frac{1}{4}$ WIDE × $\frac{3}{4}$ LONG FLAT
STAMP SIZE

REF.#	MORSE TAPER	A	B	C	D	E	F	T.P.F.
1	1	2	2.125	$1\frac{7}{8}$	$\frac{3}{8}$	.3690	.4750	.5985
2	2	$2\frac{1}{4}$	2.5625	$2\frac{1}{8}$	$\frac{3}{8}$	.5720	.7000	.5994
3	3	$2\frac{1}{2}$	3.1875	$2\frac{3}{8}$	$\frac{1}{2}$	.7780	.9380	.6023
4	4	3	4.0625	$2\frac{3}{4}$	$\frac{1}{2}$	1.0200	1.2310	.6232

DRAWING NO. 14	TAPER RING GAGE	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 12 MILLING JOB NO. 10 INTERNAL GRINDER JOB NO. 1 SURFACE GRINDER JOB NO. 1 BENCH JOB NO. 8	MATERIAL: TOOL STEEL FINISH: HDN. & GRIND SCALE: NONE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-M-1(J)

JOB SHEET
ON
ENGINE LATHE

JOB: TAPER RING GAGE

MATERIALS: ONE PIECE 3" X 4 1/8" TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, INDEPENDENT CHUCK, FACING TOOL, 1" TAPER SHANK DRILL, TURNING TOOL, CENTER DRILL, TAILSTOCK DRILL CHUCK, BORING TOOL, 1" - 2" MICROMETER, 2" - 3" MICROMETER, 3" - 4" MICROMETER, 4" - 5" MICROMETER, MILL FILE, #4 MORSE TAPERED ARBOR, KNURLING TOOL, DIAL INDICATOR, VERNIER CALIPER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, ENGINE LATHE, PP. 36-1 TO 36-44; REF. #2, ENGINE LATHE, PP. 462-494. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-L-1(TS)	SET UP AND TRUE WORKPIECE IN INDEPENDENT CHUCK
VII-B-1b(TS)	SET UP AND FACE ONE END
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL OPPOSITE END NOTE: HOLD 4.072" LENGTH. THIS WILL ALLOW .010" FOR GRINDING
VII-D-1(TS)	SET UP AND DRILL 1" HOLE
VII-M-1(TS)	SET UP AND BORE TAPERED HOLE
VII-M-1a(TS)	SET UP WORKPIECE ON TAPERED ARBOR
VII-L-1b(TS)	SET UP AND TURN 2 3/4" O. D. AS PER DRAWING
VII-C-1b(TS)	SET UP AND KNURL WORKPIECE
VII-B-1c(TS)	SET UP AND TURN 1/16" CHAMFERS AS PER DRAWING
VII-A-1c(TS)	CLEAN MACHINE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SET UP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET VII-M-1(TS)

TASK: SET UP AND BORE TAPERED HOLE

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, INDEPENDENT CHUCK, BORING TOOL, VERNIER CALIPER, 1" - 2" INSIDE MICROMETER, #4 MORSE TAPERED ARBOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE	NOTE: WORKPIECE IS CHUCKED IN INDEPENDENT CHUCK AS PREVIOUS TASK, VII-D-1(TS)
2. SET UP AND DRILL 1" DIAMETER HOLE	REFER TO: VII-D-1(TS)
3. SET UP BORING TOOL	REFER TO: VII-G-1b(TS)
4. SET UP TAPER ATTACHMENT AND BORE #4 MORSE TAPER	1. REFER TO: VII-B-1h(TS) NOTE: TAPER IS .623" PER FOOT 2. HOLD BORED DIAMETER TO 1.010" ON REF. "E" AND 1.221" ON REF. "F". THIS WILL ALLOW .010" FOR FINISH GRINDING 3. BURR EDGES 4. POLISH BORE CAUTION: DO NOT WRAP ABRASIVE AROUND FINGER. USE SMALL STICK OR ROD 5. REMOVE WORKPIECE FROM CHUCK 6. INSPECT

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #1, PP. 36-1 TO 36-44
REF. #2, PP. 462-494

TASK SHEET VII-M-1a(TS)

TASK: SET UP WORKPIECE ON TAPERED ARBOR

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TAPERED ARBOR, INDEPENDENT CHUCK, DIAL INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TAPERED ARBOR	1. CHUCK UP AND TRUE IN INDEPENDENT CHUCK AS PER PREVIOUS TASK VII-L-1(TS) NOTE: SEE FIG. 1 2. CHECK TRUENESS WITH DIAL INDICATOR
2. SET UP WORKPIECE ON MANDREL	1. WIPE MANDREL CLEAN 2. WIPE BORED HOLE ON WORKPIECE CLEAN 3. PLACE WORKPIECE ON MANDREL AS PER FIG. 2 4. SLIDE WORKPIECE ONTO MANDREL NOTE: WORKPIECE MAY BE SNUGGED UP FIRMLY BY TAPPING LIGHTLY WITH SOFT MALLET 5. TEST WORKPIECE BY ATTEMPTING TO TWIST OR PULL OFF WORKPIECE

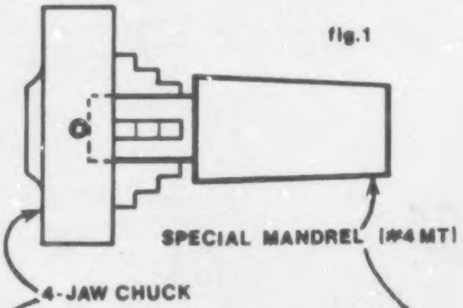


fig.1

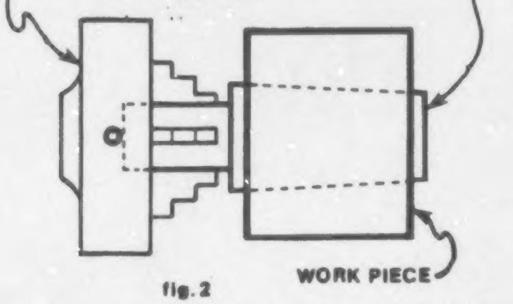


fig.2

SKETCHES: DRAWING #4: TAPER RING GAGE

REFERENCES: REF. #1, P. 36-38
REF. #2, P. 487

IX-J-1(J)

JOB SHEET
ON
HORIZONTAL MILLING MACHINE

JOB: TAPER RING GAGE

MATERIALS: TAPER RING GAGE AS MACHINED ON LATHE

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, MILL VISE, 7/8" END MILL, 7/8" END MILL HOLDER, 1/16" SLITTING SAW, ARBOR AND SPACING COLLARS, "V"-BLOCK, 0-1" DEPTH MICROMETER, 6" RULE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 38-1 TO 38-38 AND REF. #2, PP. 524 TO 564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

IX-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-B-1b(TS)	SET UP 7/8" END MILL AND HOLDER
IX-A-1a(TS)	SET UP MILL VISE
IX-A-1b(TS)	SET UP WORKPIECE IN "V"-BLOCKS NOTE: SMALL DIAMETER OF BORE WILL BE POSITIONED UP AS PER DRAWING
IX-A-1a(TS)	SET MACHINE FEED AND SPEED
IX-J-1(TS)	MACHINE .010" GO OR NO-GO" STEP RELIEF
IX-C-1a(TS)	SET UP AND MACHINE 1/4" X 3/4" FLAT AS PER DRAWING
IX-A-1b(TS)	SET UP AND MACHINE 1/16" RELIEF FOR GRINDING
IX-A-1c(TS)	CLEAN MACHINE ROUTE TO BENCH

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET IX-J -1(TS)

TASK: MACHINE .010" "GO OR NO-GO" STEP RELIEF

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, 7/8" END MILL AND HOLDER, DEPTH MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP AND MILL HOLDER AND MILL END	1. CLEAN INSIDE OF HEADSTOCK SPINDLE 2. CLEAN END MILL HOLDER 3. INSERT SPINDLE DRAW BAR CAUTION: DO NOT DAMAGE THREADS ON END OF DRAW BAR 4. INSERT END MILL HOLDER INTO SPINDLE NOTE: BE SURE NOTCHES ON HOLDER FIT OVER DRIVE DOGS ON SPINDLE 5. SCREW DRAW BAR INTO END MILL HOLDER AND TIGHTEN CAUTION: DO NOT CROSS THREAD 6. INSERT AND TIGHTEN END MILL AS IN PREVIOUS TASK IX-B-1b(TS)
2. MACHINE STEP RELIEF	1. MOVE LONGITUDINAL AND CROSS TRAVERSE FEED UNTIL WORKPIECE IS POSITIONED UNDER END MILL 2. TURN MACHINE ON NOTE: CHECK SPINDLE ROTATION AND FEED DIRECTION 3. RAISE TABLE UNTIL CUTTER MAKES CONTACT WITH WORKPIECE NOTE: PLACE A PIECE OF PAPER BETWEEN CUTTER AND WORKPIECE 4. ADJUST CROSS TRAVERSE POSITION OF TABLE UNTIL ONE SIDE OF END MILL CLEARS BORED HOLE NOTE: MOVE CUTTER IN 7/8" FROM EDGE OF WORKPIECE 5. TURN LONGITUDINAL FEED UNTIL WORKPIECE IS CLEAR CUTTER 6. RAISE VERTICAL FEED .010 7. CUT MACHINE ON

8. MACHINE .010" STEP RELIEF
   NOTE: MILL .010" STEP RELIEF TO CENTER LINE OF WORKPIECE
9. BURR EDGES

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #2, PP. 538, 539

IV-H-1(J)

JOB SHEET
ON
BENCH

JOB:	TAPER RING GAUGE
MATERIALS:	AS MACHINED ON LATHE AND MILLING MACHINE
TOOLS AND EQUIPMENT:	NUMBER AND LETTER STAMPS, BALL PEEN HAMMER, COPPER TO PROTECT KNURLED AREA
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB CHECK WITH INSTRUCTOR
PROCEDURES AND/OR TASKS:	IV-A-1(TS) STEEL STAMP #4 ON FLAT SURFACE OF WORKPIECE ROUTE TO HEAT TREAT
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. BE SURE STAMPS ARE SQUARE WITH WORKPIECE BEFORE STAMPING. 2. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

XI-E-1(J)

JOB SHEET
ON
HEAT TREAT

JOB:	TAPER RING GAUGE	
MATERIALS:	AS MACHINED ON LATHES, MILLING MACHINE, AND STEEL STAMPED	
TOOLS AND EQUIPMENT:	FURNACE, QUENCHING VAT, OIL IN VAT	
GENERAL INSTRUCTIONS:	BEFORE HEAT TREATING PROCEDURES READ REF. #1, PP. 31-1 TO 31-8 AND REF. #2, PP. 357 TO 369	
PROCEDURES AND/OR TASKS:	XI-A-1(TS)	CHECK FURNACE FOR PROPER OPERATING CONDITION
	XI-A-1a(TS)	LIGHT FURNACE
	XI-A-1b(TS)	HEAT TREAT WORKPIECE
		ROUTE TO SURFACE GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. FURNACE IN PROPER WORKING CONDITION
2. ALL INFLAMMABLE OBJECTS REMOVED
3. SAFETY IS TOP PRIORITY TO EVERYONE IN AREA
4. WORKPIECE HARDENED PROPERLY
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

X-H-1(J)

JOB SHEET
ON
SURFACE GRINDER

JOB:	TAPER RING GAGE
MATERIALS:	TAPER RING GAGE AS FINISHED ON THE LATHE, MILLING MACHINE, STAMPED AND HEAT TREATED
TOOLS AND EQUIPMENT:	SURFACE GRINDER, CORRECT GRINDING WHEEL, MAGNETIC CHUCK, DIAMOND WHEEL DRESSER, DEPTH MICROMETER, MAGNETIC BASE SCRIBE HOLDER, SCRIBE, SUPPORT BLOCKS
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, GRINDING, PP. 33-8 TO 33-13; REF. #3, PRECISION GRINDING, PP. 287-297. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:	X-H-1(TS)	CHECK SURFACE GRINDER FOR PROPER WORKING CONDITION
	X-H-1a(TS)	INSPECT AND MOUNT CORRECT GRINDING WHEEL ON SPINDLE
	X-H-1b(TS)	TRUE AND DRESS GRINDING WHEEL
	X-H-1c(TS)	SET UP AND GRIND ONE END OF RING GAGE
	X-H-1d(TS)	SET UP AND GRIND SECOND END OF RING GAGE
	X-H-1e(TS)	SET UP AND GRIND .010" STEP RELIEF ROUTE TO INTERNAL GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SET UP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS. FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET X-H-1(TS)

TASK: CHECK SURFACE GRINDER FOR PROPER WORKING CONDITION

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, LUBRICATING OIL, WIPING RAGS, MAGNETIC CHUCK, AND NECESSARY WRENCHES

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LUBRICATE MACHINE	1. PLACE ONE OR TWO DROPS OF OIL IN EACH OIL CAP 2. CHECK OIL RESERVOIR AND FILL TO PROPER LEVEL 3. CHECK TABLE RESERVOIR THAT LUBRICATES SPUR GEAR AND RACK FOR LONGITUDINAL TABLE TRAVEL 4. OIL LIGHTLY THE WAYS ON THE TABLE, SADDLE, AND COLUMN 5. CHECK FREE AND SMOOTH MOVEMENT OF TOOL HEAD, LONGITUDINAL FEED, AND CROSS FEED NOTE: REFER TO MANUFACTURER'S LUBRICATION CHART
2. INSPECT GUARDS	1. CHECK FOR CORRECT POSITION 2. INSPECT FOR FASTENED SECURELY NOTE: SPLASH GUARD MAY BE LEFT OFF UNTIL SETUP IS MADE
3. INSPECT MAGNETIC CHUCK	1. INSPECT FOR PROPERLY FASTENED TO BED 2. CHECK MAGNETIC CHUCK FOR HOLDING POWER NOTE: PLACE WORKPIECE ON CHUCK AND CUT MAGNET ON. TRY TO REMOVE WORK CAUTION: SHOULD CHUCK NOT HOLD, DO NOT START OPERATING. CALL TO THE ATTENTION OF INSTRUCTOR IMMEDIATELY
4. INSPECT ELECTRICS	1. CHECK SWITCHES ON CONTROLS FOR CUTTING MACHINE ON AND OFF

	2. INSPECT ANY WIRING FOR BARE WIRE OR SHORT 3. CHECK LAMP FOR CORRECT WATTAGE AND LIGHTING
5. CHECK COOLANT SYSTEM (IF APPLICABLE)	1. CHECK FOR LEVEL OF COOLANT IN COOLANT TANK 2. ADD COOLANT IF NECESSARY CAUTION: USE WATER SOLUBLE OIL

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #1, PP. 33-8 TO 33-13
REF. #2, PP. 287-297

TASK SHEET X-H-1a(TS)

TASK: INSPECT AND MOUNT CORRECT GRINDING WHEEL ON SPINDLE

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, SPINDLE WRENCH, GRINDING WHEEL, WIPING RAG, WOODEN MALLET, BLOTTER RINGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT GRINDING WHEEL	1. CHECK FOR CORRECT GRIT AND TYPE ABRASIVE FOR JOB. REFER TO REF. #1, P. 33-12 OR REF. #3, PP. 292-294 2. CHECK FOR SAFE OPERATING SPEED NOTE: SPEED OF MACHINE MUST NOT EXCEED SAFE RATED SPEED OF GRINDING WHEEL
2. INSPECT GRINDING WHEEL	1. CHECK WHEEL FOR CHIPS OR CRACKS NOTE: TAP WHEEL LIGHTLY WITH WOODEN MALLET. SOUND SHOULD HAVE CLEAR METALLIC RING CAUTION: SHOULD SOUND BE FLAT WITHOUT A CLEAR TONE, THE WHEEL IS CRACKED. DO NOT USE 2. INSPECT BUSHING TO INSURE CORRECT SIZE AND FIT
3. MOUNT GRINDING WHEEL ON SPINDLE	1. CLEAN GRINDING WHEEL SLEEVE 2. MOUNT THE WHEEL SLEEVE THROUGH WHEEL NOTE: PLACE A WASHER BETWEEN THE WHEEL AND EACH CLAMPING FLANGE NOTE: WASHER MAY BE RUBBER, LEATHER, OR BLOTTING PAPER. SEE FIG. 1 3. TIGHTEN THREADED FLANGE (SLEEVE NUT) ONTO WHEEL SLEEVE NOTE: WHEEL SHOULD HAVE A SNUG FIT CAUTION: DO NOT TIGHTEN SLEEVE NUT TOO TIGHT. TOO MUCH PRESSURE WILL CRACK WHEEL 4. SLIDE WHEEL SLEEVE ONTO THE SPINDLE

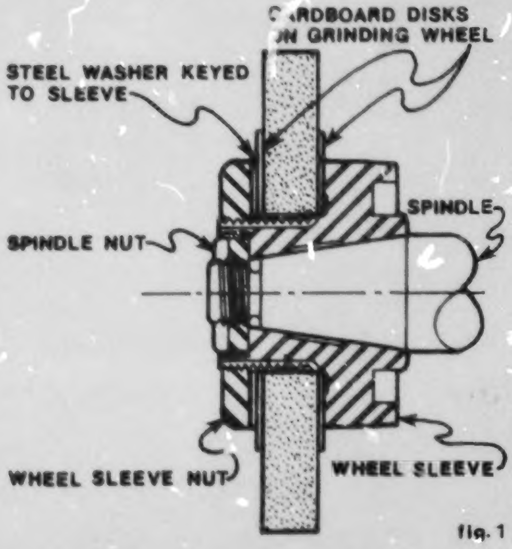

CARDBOARD DISKS ON GRINDING WHEEL
STEEL WASHER KEYED TO SLEEVE
SPINDLE
SPINDLE NUT
WHEEL SLEEVE NUT
WHEEL SLEEVE

fig. 1

	5. SEAT WHEEL SLEEVE BY HAND, ALIGNING THE KEYWAY WITH THE KEY IN THE SPINDLE
	6. DRAW SLEEVE TIGHT ON SPINDLE WITH SPINDLE NUT AND WRENCH CAUTION: TIGHTEN SECURELY. AVOID TOO MUCH PRESSURE
4. INSPECT SETUP	1. CHECK FOR WHEEL LOOSENNESS 2. CHECK FOR BALANCE 3. REPLACE ALL GUARDS

SKETCHES: DRAWING #14, TAPER RING GAGE

REFERENCES: REF. #1, PP. 33-8 TO 33-13
REF. #2, PP. 291-295

TASK SHEET X-H-1b(TS)

TASK: TRUE AND DRESS GRINDING WHEEL

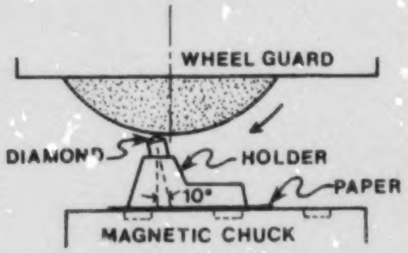
JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, MAGNETIC CHUCK, DIAMOND HOLDER, DIAMOND DRESSER, CORRECT GRINDING WHEEL

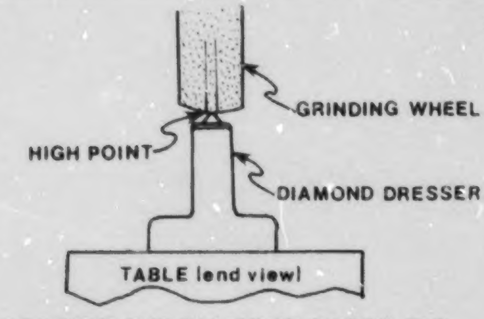
TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN MAGNETIC CHUCK	1. WIPE THOROUGHLY WITH CLEAN CLOTH 2. WIPE WITH PALM OF HAND NOTE: THE PALM WILL PICK UP VERY FINE PARTICLES THAT A RAG WILL NOT
2. CLEAN BASE OF DIAMOND HOLDER	FOLLOW THE SAME PROCEDURE AS IN STEP 1
3. SET UP DIAMOND HOLDER	1. CHECK DIAMOND FOR WEAR NOTE: TURN DIAMOND IN HOLDER TO EXPOSE SHARP CUTTING EDGE TO WHEEL IF WORN 2. PLACE PIECE OF PAPER, SLIGHTLY LARGER THAN BASE, BETWEEN CHUCK AND BASE NOTE: THIS WILL PREVENT SCRATCHING CHUCK 3. POSITION DIAMOND HOLDER ON PAPER NOTE: HOLDER SHOULD COVER AS MANY MAGNETIC INSERTS AS POSSIBLE 4. TURN MAGNET ON 5. TWIST HOLDER TO INSURE MAGNET IS HOLDING PROPERLY
4. POSITION DIAMOND FOR DRESSING WHEEL	1. RAISE WHEEL SLIGHTLY ABOVE THE HEIGHT OF THE DIAMOND 2. MOVE TABLE LONGITUDINALLY SO DIAMOND IS POSITIONED ABOUT 1/4" TO THE LEFT OF CENTER LINE OF WHEEL. SEE FIG. 1 NOTE: THIS WILL PREVENT DAMAGE TO THE WHEEL IN CASE OF POWER FAILURE NOTE: THIS POSITION WILL PREVENT CHATTER AND THE DIAMOND FROM DIGGING IN



PROPER POSITIONING OF THE DIAMOND DRESSER

fig. 1



POSITION THE DIAMOND UNDER THE HIGH POINT OF THE WHEEL
fig.2

3. POSITION TABLE SO DIAMOND IS UNDER THE HIGH POINT OF WHEEL. SEE FIG. 2
   NOTE: THIS IS IMPORTANT AS WHEELS WEAR MORE ON THE EDGE THAN CENTER

5. DRESS AND TRUE WHEEL
   1. START MACHINE
   2. CAREFULLY LOWER TOOL HEAD UNTIL HIGH POINT OF WHEEL TOUCHES DIAMOND
   3. TURN CROSS FEED HANDWHEEL FEEDING DIAMOND ACROSS FULL FACE OF WHEEL
   4. LOWER GRINDING WHEEL .001" TO .002"
   5. FEED DIAMOND DRESSER ACROSS FACE OF WHEEL
      NOTE: RATE OF CROSS FEED WILL VARY WITH WHEEL STRUCTURE. FEED FAST FOR COARSE WHEELS AND SLOW FOR FINE, CLOSE SPACED WHEELS
      NOTE: IF COOLANT IS TO BE USED DURING GRINDING OPERATION, DRESS WHEEL USING COOLANT
   6. REPEAT PROCEDURE UNTIL FACE OF WHEEL IS FLAT AND TRUE
   7. LOWER GRINDING WHEEL .0005" FOR FINISH DRESSING OF WHEEL
      NOTE: IF RAPID REMOVAL OF METAL IS MORE IMPORTANT THAN SURFACE FINISH, DO NOT FINISH DRESS WHEEL
      NOTE: MAKE SEVERAL PASSES ACROSS FACE OF WHEEL TO SPARK OUT

6. SECURE MACHINE
   1. TURN COOLANT OFF
   2. TURN MACHINE OFF
   3. TURN MAGNETIC CHUCK OFF
      CAUTION: DO NOT CUT OFF MAGNETIC SWITCH UNTIL WHEEL HAS STOPPED

4. REMOVE DIAMOND HOLDER
5. RETURN DIAMOND TO PROPER STORAGE
6. WIPE MAGNETIC CHUCK CLEAN

SKETCHES: DRAWING #14: TAPER RING GAGE

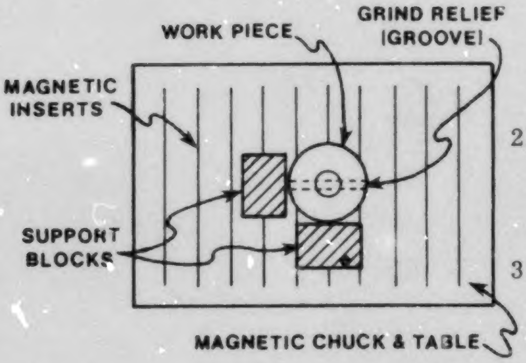
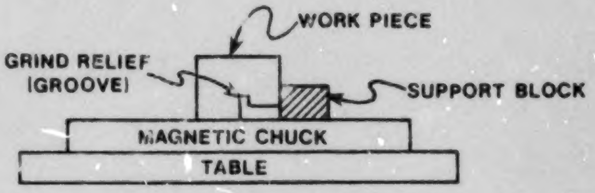
REFERENCES: REF. #1, PP. 33-11 TO 33-12
REF. #2, P. 575
REF. #3, PP. 295-297

TASK SHEET

X-H-1c(TS)

TASK:	SET UP AND GRIND ONE END OF RING GAGE
JOB:	TAPER RING GAGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SURFACE GRINDER, MAGNETIC CHUCK, TWO SUPPORT BLOCKS, CORRECT GRINDING WHEEL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN MAGNETIC CHUCK	USE PROCEDURE AS PER X-H-1b(TS) STEP 1
2. CLEAN AND INSPECT WORKPIECE	1. INSPECT EDGES FOR BURRS NOTE: REMOVE BURRS WITH FILE IF NECESSARY 2. WIPE ENDS CLEAN NOTE: USE PROCEDURE FOLLOWED IN CLEANING MAGNETIC CHUCK
3. SET UP WORK  WORK PIECE GRIND RELIEF (GROOVE) MAGNETIC INSERTS SUPPORT BLOCKS MAGNETIC CHUCK & TABLE fig. 1	1. POSITION WORKPIECE ON MAGNETIC CHUCK NOTE: PLACE STEP END DOWN WITH GROOVE PARALLEL TO TABLE CAUTION: WORKPIECE MUST STRADDLE AS MANY MAGNETIC INSERTS AS POSSIBLE. SEE FIG. 1 AND FIG. 2 2. POSITION TWO SUPPORT BLOCKS AGAINST WORKPIECE AS PER FIG. 1 NOTE: THIS WILL GIVE SUPPORT TO WORKPIECE AND KEEP FROM TILTING 3. TURN MAGNETIC CHUCK ON  WORK PIECE GRIND RELIEF (GROOVE) SUPPORT BLOCK MAGNETIC CHUCK TABLE fig. 2
4. SET TABLE DOGS	1. CENTER GRINDING WHEEL ABOUT 1/8" ABOVE WORKPIECE 2. SET TABLE REVERSING DOGS SO CENTER OF GRINDING WHEEL CLEARS EACH END OF WORKPIECE APPROXIMATELY 1"

	NOTE: THIS WILL PERMIT DIRECTION OF TABLE TO REVERSE AFTER CLEARING WORKPIECE NOTE: THE PROCEDURE IS THE SAME FOR MANUAL CONTROL TYPE SURFACE GRINDER
5. GRIND WORKPIECE	1. SET CROSS FEED FOR .030" FEED NOTE: THIS IS APPLICABLE ONLY TO AUTOMATIC FEED MACHINES 2. POSITION GRINDING WHEEL DIRECTLY OVER WORKPIECE NOTE: 1/8" ABOVE WORK 3. START GRINDER 4. LOWER GRINDING WHEEL UNTIL WHEEL JUST SPARKS THE WORK 5. RAISE WHEEL .005" AND MOVE WHEEL TO STARTING POSITION NOTE: THIS INSURES CLEARANCE OF WHEEL IN POSITIONING FOR STARTING 6. LOWER GRINDING WHEEL TO ORIGINAL CONTACT POINT .005" 7. LOWER WHEEL TO TAKE .002" CUT 8. START TABLE FEED NOTE: FEED ENTIRE WIDTH OF WORKPIECE 9. CUT ON COOLANT IF APPLICABLE 10. CONTINUE TO LOWER WHEEL AFTER EACH CUT TO MINIMUM CLEANUP NOTE: ONLY .005" IS TO BE REMOVED ON EACH END
6. REMOVE WORKPIECE	1. TURN TABLE FEED OFF 2. TURN OFF COOLANT 3. TURN MACHINE OFF 4. TURN MAGNETIC CHUCK OFF CAUTION: DO NOT TURN CHUCK OFF OR REMOVE WORKPIECE UNTIL MACHINE IS COMPLETELY STOPPED 5. REMOVE WORKPIECE FROM CHUCK 6. BURR EDGES CAREFULLY 7. CLEAN MAGNETIC CHUCK AND SUPPORT BLOCKS

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #1, P. 33-7 TO 33-10
REF. #2, PP. 295-298

TASK SHEET X-H-1d(TS)

TASK:	SET UP AND GRIND SECOND END OF RING GAGE
JOB:	TAPER RING GAGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SURFACE GRINDER, MAGNETIC CHUCK, SUPPORT BLOCKS, DEPTH MICROMETER, MAGNETIC BASE SCRIBE HOLDER WITH SCRIBE, 4" - 5" OUTSIDE MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE MAGNETIC CHUCK AND WORKPIECE	SAME PROCEDURE AS PER STEPS 1 AND 2, TASK X-H-1c(TS)
2. SET UP WORKPIECE	1. MIKE OVERALL LENGTH OF WORKPIECE NOTE: SHOULD READ 4.0670"
	2. PLACE GROUND END OF WORKPIECE ON CHUCK. REFER TO: X-H-1c(TS) STEP
	3. SUPPORT WORKPIECE WITH SUPPORTING BLOCKS. SEE FIG. 1, X-H-1c(TS)
	4. ATTACH MAGNETIC BASE SCRIBE HOLDER TO GRINDER WHEEL GUARD
	5. ATTACH SCRIBE TO HOLDER NOTE: SCRIBE POINT SHOULD BE POSITIONED DOWNWARD AND EXTENDED CLEAR OF GRINDING WHEEL. SEE FIG. 1
	6. LOWER GRINDING WHEEL UNTIL SCRIBE POINT IS SLIGHTLY BELOW TOP OF WORKPIECE NOTE: DO NOT LOWER WHEEL BELOW RELIEF
	7. TURN CROSS FEED HANDWHEEL UNTIL SCRIBE POINT TOUCHES SHOULDER OF RELIEF
	8. CAREFULLY MOVE TABLE BACK AND FORTH
	9. ADJUST WORKPIECE BY HAND UNTIL SCRIBE POINT AND WORKPIECE SHOULDER ARE PARALLEL NOTE: WHERE PRECISION PARALLELISM IS REQUIRED USE DIAL INDICATOR INSTEAD OF SCRIBE
	10. CHECK SUPPORT BLOCKS
	11. TURN MAGNETIC CHUCK ON

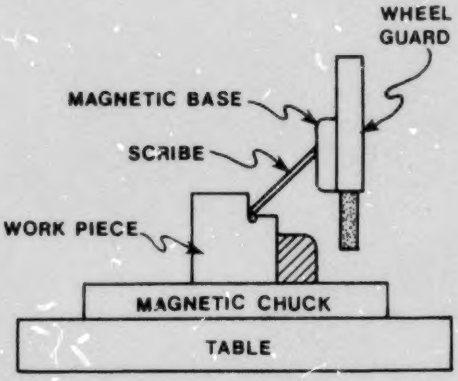


fig. 1

	12. REMOVE SCRIBE AND HOLDER
3. SET TABLE DOGS	REFER TO X-H-1c(TS) STEP 4
4. GRIND WORKPIECE	1. SAME PROCEDURE IS FOLLOWED AS PER X-H-1c(TS) STEP 5 2. MEASURE WITH DEPTH MICROMETER NOTE: HOLD 4.0625" NOTE: APPROXIMATELY .004" TO .005" SHOULD BE REMOVED 3. TURN OFF MACHINE 4. LEAVE SET UP FOR NEXT OPERATION

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #1, PP. 33-7 TO 33-10
REF. #2, PP. 295-298

TASK SHEET

X-H-1e(TS)

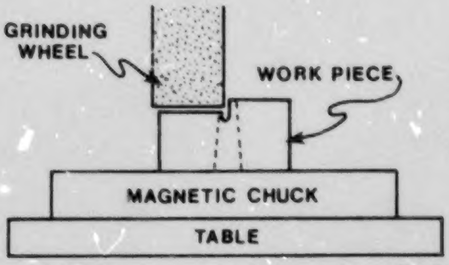
TASK: GRIND .010" STEP ON TAPER RING GAGE

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, MAGNETIC CHUCK, SUPPORT BLOCKS, DEPTH MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE FOR GRINDING STEP	1. SET UP AS PREVIOUS TASK 2. MEASURE DISTANCE FROM TOP END OF WORKPIECE TO STEP NOTE: DISTANCE SHOULD BE .005" NOTE: GRINDING WHEEL WILL BE LOWERED TO FINISH .010" RELIEF
2. GRIND RELIEF  fig.1	1. POSITION GRINDING WHEEL. SEE FIG. 1 HOLD ONE EDGE OF WHEEL 2. LOWER GRINDING WHEEL UNTIL WHEEL TOUCHES WORKPIECE 3. FEED WORK BACK AND FORTH LONGITUDINALLY UNTIL WHEEL SPARKS OUT 4. LOWER GRINDING WHEEL .001" AT A TIME UNTIL DEPTH OF STEP IS REACHED HOLD: .010" FROM TOP
3. REMOVE WORKPIECE	1. CUT COOLANT OFF IF USED 2. TURN MACHINE OFF 3. TURN MAGNETIC CHUCK OFF CAUTION: DO NOT CUT OFF UNTIL WHEEL HAS STOPPED 4. REMOVE WORKPIECE FROM CHUCK 5. BURR EDGES CAREFULLY 6. INSPECT FOR SPECIFIED DIMENSIONS AS PER DRAWING 7. CLEAN MACHINE ROUTE TO UNIVERSAL GRINDER

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #1, PP. 33-8 TO 33-13
REF. #2, PP. 287-297

X-H-2(J)

JOB SHEET
ON
INTERNAL GRINDER

JOB: TAPER RING GAGE

MATERIALS: WORKPIECE AS MACHINED ON THE LATHE, MILLING MACHINE, STAMPED, HEAT TREATED, AND SURFACE GROUND

TOOLS AND EQUIPMENT: INTERNAL GRINDER, CORRECT GRINDING WHEEL, STANDARD TAPER PLUG GAGE, DIAL INDICATOR, DIAMOND DRESSING TOOL, PRUSSIAN BLUE, INDEPENDENT CHUCK OR COLLET, 1" - 2" MICROMETER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, GRINDING, PP. 33-1 TO 33-15; REF. #3, PRECISION GRINDING, PP. 297-310; REF. #4, GRINDING MACHINES, PP. 446-470. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

NOTE: JOB AND TASK SHEETS FOR THIS OPERATION WILL BE WRITTEN FOR THE INTERNAL GRINDER, UNIVERSAL GRINDER, AND THE LATHE. THE MACHINE TO BE USED WILL BE LEFT TO THE DISCRETION OF THE INSTRUCTOR

PROCEDURES AND/OR TASKS:

X-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
X-H-2(TS)	SET UP TOOLING FOR INTERNAL GRINDING
VII-L-1(TS)	TRUE WORKPIECE IN INDEPENDENT CHUCK NOTE: COLLET MAY BE USED IF AVAILABLE
X-H-2a(TS)	GRIND INTERNAL TAPER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET X-H-2(TS)

TASK: SET UP TOOLING FOR INTERNAL GRINDING

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: INTERNAL GRINDER, INDEPENDENT CHUCK, DIAL INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET FEED AND SPEED	1. SET FEED AT 12" PER MINUTE
	2. SET INTERNAL GRINDING SPINDLE (QUILL) APPROXIMATELY 10,000 RPM NOTE: THIS WILL GIVE A SURFACE SPEED OF 4,000 SFM CAUTION: DO NOT EXCEED 6,500 SFM
	3. SET HEADSTOCK SPEED APPROXIMATELY 300 RPM
2. SET UP WHEEL STAND (WORK HEAD)	1. SET WHEEL STAND ON ZERO DEGREES
	2. INSPECT INTERNAL GRINDING QUILL FOR CORRECT SET UP
	3. INSTALL CORRECT GRINDING WHEEL NOTE: 3/4" WHEEL WILL BE USED
3. DRESS GRINDING WHEEL	1. MOUNT DRESSING TOOL AND HOLDER TO TABLE. REFER TO FIG. 1
	2. POSITION DIAMOND AT 10° - 15° ANGLE TO FACE OF WHEEL. REFER TO FIG. 2
	3. LOCATE DIAMOND ON CENTER OR SLIGHTLY BELOW CENTER OF WHEEL. REFER TO FIG. 1
	4. REFER TO X-A-1a(TS) OR X-H-1b(TS) FOR PROCEDURE IN DRESSING WHEEL NOTE: METHOD WILL VARY WITH TYPE OF WHEEL DRESSING ATTACHMENT
	5. INSPECT WHEEL FOR SMOOTH AND ROUND FINISH

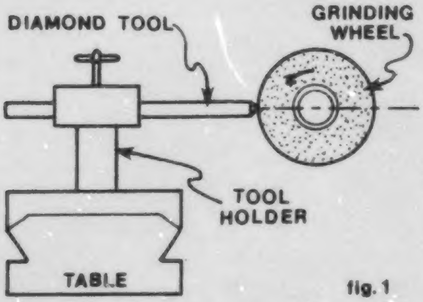


fig. 1

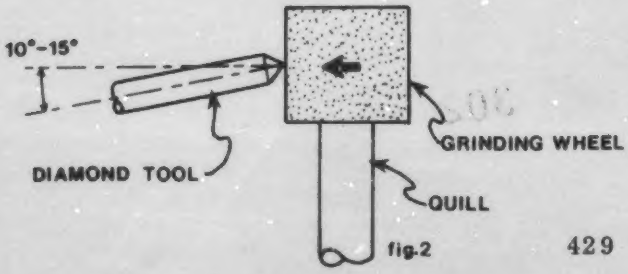


fig.2

4. SET UP HEADSTOCK	1. MOUNT FOUR-JAW CHUCK. REFER TO VII-L-1(TS) ON LATHE 2. SET HEADSTOCK FOR .6232" TAPER PER FOOT

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #4, PP. 446-470

TASK SHEET X-H-2a(TS)

TASK: GRIND INTERNAL TAPER (.6232 TPF)

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: INTERNAL GRINDER, INDEPENDENT CHUCK, STANDARD PLUG GAGE #4 MORSE TAPER, 1" - 2" MICROMETER, PRUSSIAN BLUE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET REVERSING DOGS	1. POSITION GRINDING WHEEL INSIDE OF HOLE BY TURNING CROSS FEED HANDWHEEL AND LONGITUDINAL HANDWHEEL NOTE: DO NOT LET WHEEL TOUCH SIDE OF HOLE 2. MOVE WHEEL LONGITUDINALLY TO THE LEFT UNTIL 1/2 OF GRINDING WHEEL PROTRUDES FROM SMALL DIAMETER HOLE CAUTION: DO NOT LET WHEEL CLEAR HOLE, AS THIS WILL CAUSE "BELL-MOUTHING" 3. SET LEFT HAND TRIP DOG 4. MOVE GRINDING WHEEL TO RIGHT UNTIL WHEEL PROTRUDES 1/4 TO 1/2 OF GRINDING WHEEL NOTE: ANY SLACK IN SPINDLE OR QUILL WILL CAUSE "BELLMOUTHING" 5. SET RIGHT HAND TRIP DOG 6. CHECK REVERSING DOGS TO INSURE CORRECT REVERSING
2. GRIND TAPER	1. POSITION GRINDING WHEEL AT STARTING POINT 2. TURN GRINDING WHEEL SPINDLE ON 3. TURN HEADSTOCK SPINDLE ON 4. HAND FEED GRINDING WHEEL OUT WITH CROSS FEED HAND WHEEL UNTIL WHEEL TOUCHES WORKPIECE 5. SET CROSS FEED DIAL ON "0" 6. CLOSE SPLASH GUARD IF APPLICABLE 7. CUT ON COOLANT PUMP IF APPLICABLE

NOTE: DO NOT CUT ON COOLANT PUMP UNTIL GRINDING WHEEL TOUCHES WORKPIECE AS IT MAKES IT DIFFICULT TO DETERMINE ACUTAL CONTACT BETWEEN WHEEL AND WORKPIECE

8. TURN CROSS FEED OUT .001" (INTO WORKPIECE)
9. ENGAGE AUTOMATIC FEED
   NOTE: PERMIT GRINDING WHEEL TO COMPLETE THREE OR FOUR CYCLES IN AND OUT OF WORKPIECE
10. DISENGAGE AUTOMATIC FEED
11. TURN CROSS FEED OUT .001"
    NOTE: REPEAT PROCEDURE UNTIL HOLE HAS BEEN CLEANED UP
12. RETRACT TABLE FROM GRINDING WHEEL
13. TURN COOLANT OFF
14. TURN HEADSTOCK SPINDLE OFF
15. TURN QUILL SPINDLE OFF
16. WIPE WORKPIECE DRY WITH RAG

3. INSPECT TAPER AND DIAMETER OF HOLE

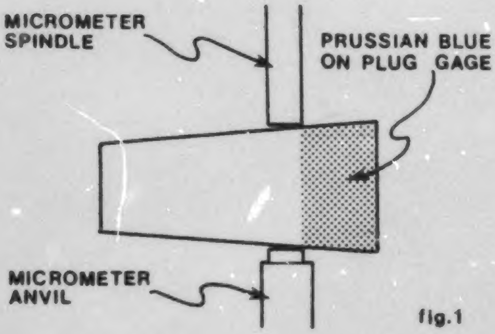


fig.1

1. APPLY LIGHT COAT OF PRUSSIAN BLUE TO STANDARD PLUG GAGE
2. INSERT PLUG FIRMLY INTO TAPERED HOLE
   NOTE: INSERT THE END COATED WITH DYE
3. TWIST PLUG GAGE SLIGHTLY
4. REMOVE PLUG GAGE FROM HOLE CAREFULLY
5. INSPECT PLUG GAGE
   NOTE: IF MACHINE IS SET FOR CORRECT TAPER, PRUSSIAN BLUE WILL BE REMOVED FROM ENTIRE LENGTH OF PLUG INSERTED INTO HOLE
   NOTE: THE PRUSSIAN BLUE WILL HAVE RUBBED OFF ON THE HOLE OF THE WORKPIECE
6. MEASURE THE DIAMETER OF PLUG GAGE WHERE PRUSSIAN BLUE REMAINS. SEE FIG. 1
   NOTE: MICROMETER READING WILL INDICATE HOW MUCH MORE STOCK MUST BE REMOVED

7. CONTINUE GRINDING PROCEDURE AS IN STEP 2 UNTIL GRINDING OPERATION IS COMPLETE

   NOTE: HOLD SPECIFIED DIMENSIONS AS PER DRAWING. 1.2310" ON LARGE DIAMETER AND 1.0200" ON SMALL DIAMETER

4. SECURE MACHINE
   1. REMOVE WORKPIECE
   2. REMOVE AND CLEAN ANY EQUIPMENT TO BE STORED
   3. CLEAN AND WIPE DOWN MACHINE. AS PER X-A-1c(TS)

SKETCH: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #4, PP. 446-470

X-H-3(J)

JOB SHEET
ON
TOOL POST GRINDER

JOB: TAPER RING GAGE

MATERIALS: WORKPIECE AS MACHINED ON THE LATHE, MILLING MACHINE, STAMPED, HEAT TREATED, AND SURFACE GROUND

TOOLS AND EQUIPMENT: ENGINE LATHE, TOOL POST GRINDER, INTERNAL GRINDING ATTACHMENT, CORRECT GRINDING WHEEL, DIAL INDICATOR, DIAMOND DRESSING TOOL, STANDARD TAPER PLUG GAGE, INDEPENDENT CHUCK, 1" - 2" MICROMETER, PRUSSIAN BLUE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #3, THE LATHE, PP. 196-198; REF. #5, THE ENGINE LATHE, P. 190. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE
NOTE: THIS JOB IS AN ALTERNATE INTERNAL GRINDING OPERATION WHEREBY AN INTERNAL GRINDER OR UNIVERSAL GRINDER IS NOT AVAILABLE

PROCEDURES AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER WORKING CONDITION
VII-L-1(TS)	SET UP AND TRUE WORKPIECE IN FOUR-JAW CHUCK
X-H-3(TS)	SET UP TOOLING FOR INTERNAL GRINDING ON LATHE
X-H-2(TS)	DRESS GRINDING WHEEL
X-H-3a(TS)	GRIND TAPER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK PROPER OPERATING CONDITION OF MACHINE.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET X-H-3(TS)

TASK: SET UP TOOLING FOR INTERNAL GRINDING

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TOOL POST GRINDER, INTERNAL GRINDING ATTACHMENT, CORRECT GRINDING WHEEL, INDEPENDENT CHUCK

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TOOL POST GRINDER	1. REMOVE EXTERNAL GRINDING QUILL FROM MOTOR HEAD 2. MOUNT INTERNAL GRINDING ATTACHMENT 3. INSTALL 3/4" GRINDING WHEEL NOTE: INSPECT FOR CORRECT WIDTH AND RATED SPINDLE SPEED 4. REMOVE PREVIOUS TOOLING FROM COMPOUND REST NOTE: REMOVE TOOL POST, TOOL HOLDER, AND OTHER TOOLING 5. WIPE COMPOUND REST AND BASE OF TOOL POST GRINDER 6. MOUNT TOOL POST GRINDER AND ATTACHMENT AT CENTER HEIGHT ON COMPOUND REST. SEE FIG. 2, FRONT OF LATHE NOTE: IF TAPER IS TO BE HAND FED OFF COMPOUND REST, SET COMPOUND REST TO REQUIRED ANGLE FIRST 7. POSITION TOOL POST GRINDER SO CENTER OF INTERNAL GRINDER QUILL AND CENTER AXIS OF WORKPIECE ARE THE SAME NOTE: GRINDER WHEEL WILL BE ON CENTER WITH WORKPIECE. SEE FIG. 1, TOP VIEW 8. TIGHTEN TOOL POST GRINDER BASE TO COMPOUND REST 9. SET TAPER ATTACHMENT FOR REQUIRED TAPER OR .6232" PER FOOT.

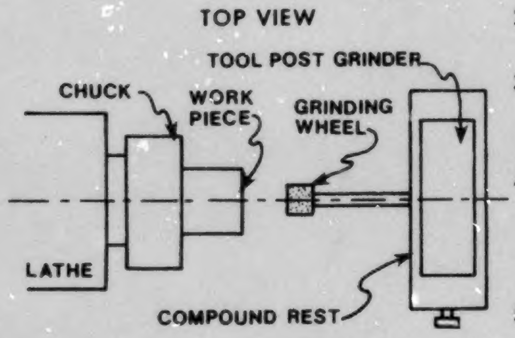

TOP VIEW
TOOL POST GRINDER
CHUCK
WORK PIECE
GRINDING WHEEL
LATHE
COMPOUND REST

fig.1

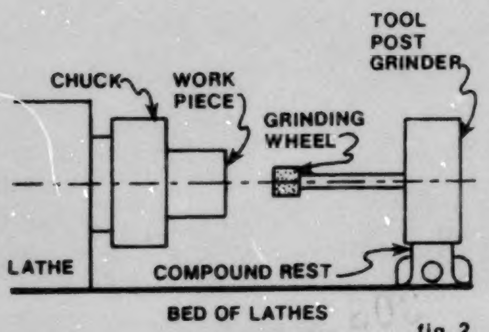

TOOL POST GRINDER
CHUCK
WORK PIECE
GRINDING WHEEL
LATHE
COMPOUND REST
BED OF LATHES

fig. 2

	REFER TO: VII-B-1h(TS)
	10. PROTECT WAYS FROM ABRASIVES NOTE: A PROTECTIVE CLOTH OR PAN MAY BE USED ESPECIALLY FOR DRY GRINDING
2. SET FEED AND SPEED OF LATHE	1. SET SPINDLE SPEED APPROXIMATELY 300 RPM 2. SET LONGITUDINAL FEED FOR .040" TO .060" FEED NOTE: FEED WILL BE TOWARD HEADSTOCK

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #3, PP. 196-198
REF. #5, P. 190

TASK SHEET X-H-3a(TS)

TASK: GRIND TAPER

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TOOL POST GRINDER, INTERNAL GRINDING ATTACHMENT, CORRECT GRINDING WHEEL, INDEPENDENT CHUCK, STANDARD TAPER PLUG GAGE, DIAL INDICATOR, PRUSSIAN BLUE, 1" - 2" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET LONGITUDINAL TRAVEL	1. POSITION GRINDING WHEEL INSIDE OF HOLE NOTE: DO NOT LET WHEEL TOUCH SIDE OF HOLE 2. MOVE CARRIAGE TO THE LEFT UNTIL 1/4 TO 1/2 OF GRINDING WHEEL PROTRUDES FROM SMALL HOLE CAUTION: DO NOT LET GRINDING WHEEL CLEAR HOLE COMPLETELY 3. SET LEFT HAND FEED STOP, IF AVAILABLE NOTE: A LINE MAY BE SCRIBED LIGHTLY ON QUILL 4. MOVE CARRIAGE TO THE RIGHT UNTIL 1/4 TO 1/2 OF WHEEL PROTRUDES INTO HOLE
2. GRIND TAPER	1. TURN HEADSTOCK SPINDLE ON NOTE: USE SAME ROTATION AS FOR TURNING 2. TURN TOOL POST GRINDER ON NOTE: GRINDING WHEEL ROTATION IS OPPOSITE OF LATHE SPINDLE, FIG. 1 3. HAND FEED GRINDING WHEEL OUT WITH CROSSFEED HAND WHEEL UNTIL WHEEL TOUCHES WORKPIECE NOTE: COMPOUND REST MAY BE USED IF SET ON 90° 4. SET CROSS FEED DIAL ON 0" 5. CUT ON COOLANT PUMP IF APPLICABLE

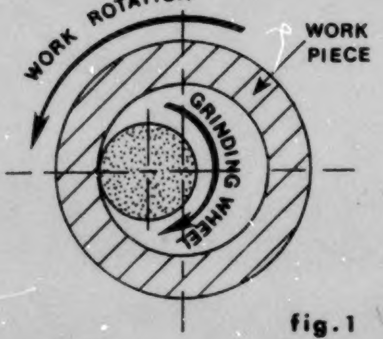
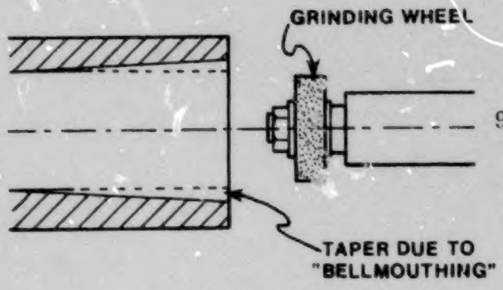


fig. 1

NOTE: DO NOT CUT PUMP ON UNTIL GRINDING WHEEL TOUCHES WORKPIECE AND CROSS SLIDE IS SET

6. FEED GRINDING WHEEL OUT .001"
7. ENGAGE LONGITUDINAL FEED
   NOTE: OBSERVE PROPER OPERATION OF TAPER ATTACHMENT
8. DISENGAGE FEED WHEN CARRIAGE TOUCHES LEFT HAND FEED STOP OR WHEN 1/4 TO 1/2 OF WHEEL PROTRUDES OUT OF HOLE
9. REVERSE FEED DIRECTION
   NOTE: FEED OUT UNTIL 1/4 TO 1/2 OF WHEEL PROTRUDES FROM HOLE
   CAUTION: DO NOT PERMIT WHEEL TO CLEAR HOLE AT EITHER END AS THIS WILL CAUSE "BELLMOUTHING", FIG. 2
10. REPEAT PROCEDURE BY FEEDING OUT .001" EACH TIME UNTIL HOLE IS CLEANED UP
11. MOVE CARRIAGE TO THE RIGHT UNTIL WHEEL CLEARS WORKPIECE
12. TURN OFF LATHE SPINDLE AND TOOL POST GRINDER
    NOTE: CUT OFF COOLANT PUMP IF USED
13. WIPE WORKPIECE DRY WITH RAG


GRINDING WHEEL
TAPER DUE TO "BELLMOUTHING"

"BELLMOUTHING"

fig. 2

3. INSPECT TAPER AND DIAMETER

1. PROCEDURE WILL BE THE SAME AS PROCEDURE IN X-H-2a(TS) STEP 3. SEE FIG. 3
2. CONTINUE GRINDING PROCEDURE UNTIL COMPLETION OF GRINDING OPERATION
   NOTE: HOLD SPECIFIED DIMENSIONS AS PER DRAWING

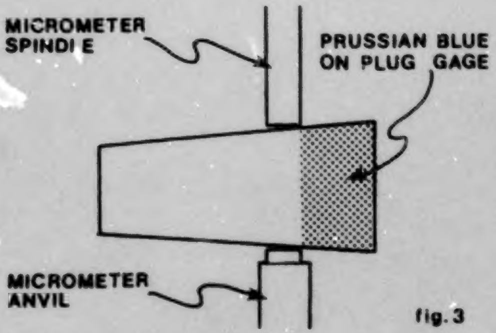

MICROMETER SPINDLE
PRUSSIAN BLUE ON PLUG GAGE
MICROMETER ANVIL

fig. 3

4. SECURE MACHINE	1. REMOVE WORKPIECE 2. CLEAN TOOL POST GRINDER AND REMOVE FROM LATHE NOTE: PLACE IN PROPER STORAGE AREA 3. CLEAN MACHINE AS PER VII-A-1c(TS)
SKETCHES:	DRAWING #14: TAPER RING GAGE
REFERENCES:	REF. #3, PP. 196-198 REF. #5, P. 180

X-H-4(J)

JOB SHEET
ON
UNIVERSAL TOOL AND CUTTER GRINDER

JOB: TAPER RING GAGE

MATERIALS: WORKPIECE AS MACHINED ON LATHE, MILLING MACHINE, STAMPED, HEAT TREATED, AND SURFACE GROUND

TOOLS AND EQUIPMENT: UNIVERSAL TOOL AND CUTTER GRINDER, HEADSTOCK, WHEEL HEAD (WORK HEAD), INTERNAL GRINDING QUILL WITH 3/[illegible]" GRINDING WHEEL, DIAMOND DRESSING TOOL AND HOLDER, STANDARD TAPER PLUG GAGE, DIAL INDICATOR, INDEPENDENT CHUCK, PRUSSIAN BLUE, 1" -2" MICROMETER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, GRINDING, PP. 33-1 TO 33-15; REF. #3, PRECISION GRINDING, PP. 297-310; REF. #4, GRINDING MACHINES, PP. 446-470; REF. #5, GRINDING MACHINES, PP. 357-369. NOTE: THIS IS AN ALTERNATE METHOD FOR INTERNAL GRINDING. SOME TASKS AND STEPS WILL BE REFERRED TO PREVIOUS JOBS X-H-2(J) AND X-H-3(J) WHERE THEY ARE THE SAME

PROCEDURE AND/OR TASKS:

X-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
X-H-4(TS)	SET UP TOOL AND CUTTER GRINDER FOR INTERNAL GRINDING
VII-L-1(TS)	TRUE WORKPIECE IN INDEPENDENT CHUCK
X-H-4a(TS)	GRIND INTERNAL TAPER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION.
2. CHECK MACHINE FOR PROPER SETUP.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET X-H-4(TS)

TASK: SET UP TOOL AND CUTTER GRINDER FOR INTERNAL GRINDING

JOB: TAPER RING GAGE

TRADE: MACHINIST

TOOLS AND MATERIALS: UNIVERSAL TOOL AND CUTTER GRINDER, HEADSTOCK, WHEEL HEAD (WORK HEAD), INTERNAL GRINDING QUILL WITH 3/4" GRINDING WHEEL, DIAMOND WHEEL DRESSER AND HOLDER, INDEPENDENT CHUCK, DIAL INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WHEEL STAND	1. MOUNT TEST BAR IN WHEEL HEAD SPINDLE
	2. ALIGN TEST BAR VERTICALLY NOTE: SET DIAL INDICATOR BASE ON TABLE AND INDICATE ON TOP OF TEST BAR
	3. MOUNT INTERNAL GRINDING ATTACHMENT ON WORK HEAD NOTE: REFER TO OPERATOR'S HANDBOOK FROM FACTORY
	4. CENTER GRINDING WHEEL SPINDLE NOTE: USE CENTERING GAGE
	5. MOUNT 3/4" GRINDING WHEEL ON SPINDLE NOTE: CHECK WHEEL FOR RATED SPEED AND GRIT
2. DRESS GRINDING WHEEL	1. REFER TO STEP 3, X-H-2(TS)
	2. PLACE PAN WITH WATER OR COVER TO PROTECT WAYS FROM GRINDER DUST
3. SET UP HEADSTOCK	1. SET HEADSTOCK AT .6232" TAPER PER FOOT NOTE: TAPER MAY BE SET BY SETTING ANGLE AT THE WORK HEAD OR BY SWIVELING TABLE TO DESIRED TAPER
	2. MOUNT WORKPIECE IN INDEPENDENT CHUCK AND TRUE. REFER TO VII-L-1(TS) ON ENGINE LATHE
4. SET FEED AND SPEED	1. SET FEED AT 12" PER MINUTE
	2. SET INTERNAL GRINDING SPINDLE APPROXIMATELY 10,000 RPM

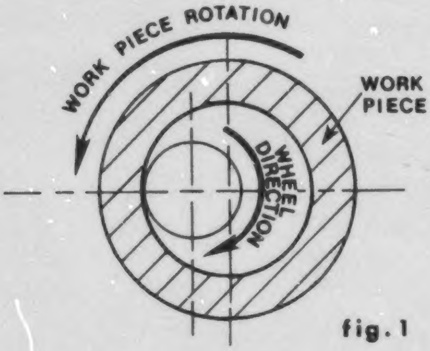

WORK PIECE ROTATION
WORK PIECE
WHEEL DIRECTION

fig. 1

NOTE: SURFACE SPEED OF 4,000 SFM
CAUTION: DO NOT EXCEED 65000 SFM

3. SET HEADSTOCK SPINDLE SPEED APPROXIMATELY 300 RPM
4. NOTE: WORKPIECE ROTATION AND GRINDING WHEEL ROTATION ARE OPPOSITE DIRECTION. SEE FIG. 1

SKETCHES: DRAWING #14, TAPER RING GAGE

REFERENCES: REF. #4, PP. 469-470
REF. #5, P. 367

314

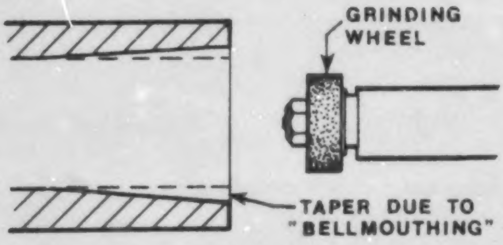
TASK SHEET

X-H-4a(TS)

TASK:	GRIND INTERNAL TAPER
JOB:	TAPER RING GAGE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	UNIVERSAL TOOL AND CUTTER GRINDER, HEADSTOCK, WHEEL HEAD (WORK HEAD), INTERNAL GRINDING QUILL WITH 3/4" GRINDING WHEEL, STANDARD TAPER PLUG GAGE, PRUSSIAN BLUE, 1" - 2" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET TABLE TRAVEL	1. POSITION GRINDING WHEEL INSIDE OF HOLE BY TURNING CROSS FEED HANDWHEEL AND LONGITUDINAL HANDWHEEL NOTE: DO NOT LET WHEEL TOUCH SIDE OF HOLE 2. MOVE LONGITUDINAL HANDWHEEL TO THE LEFT UNTIL 1/4 TO 1/2 OF GRINDWHEEL PROTRUDES FROM SMALL DIAMETER OF HOLE 3. SET LEFT TABLE DOG 4. MOVE GRINDING WHEEL TO THE RIGHT UNTIL WHEEL PROTRUDES OUT 1/4 TO 1/2 OF GRINDING WHEEL WIDTH NOTE: PERMITTING WHEEL TO COMPLETELY CLEAR HOLE ON EITHER END WILL CAUSE "BELLMOUTHING". SEE FIG. 1 NOTE: SLACK IN SPINDLE OR TOO HEAVY A FEED WILL ALSO CAUSE "BELLMOUTHING" 5. SET RIGHT TABLE DOG 6. CHECK LONGITUDINAL TRAVEL TO INSURE CORRECT STOPPING POINTS
2. GRIND TAPER	1. POSITION GRINDING WHEEL AT STARTING POINT NOTE: WHEEL ABOUT 1/2 INTO HOLE 2. TURN GRINDING WHEEL SPINDLE ON 3. TURN HEADSTOCK SPINDLE ON 4. HAND FEED GRINDING WHEEL OUT UNTIL WHEEL TOUCHES WORKPIECE LIGHTLY



BELLMOUTHING

fig. 1

5. SET CROSS-FEED DIAL ON "0"
6. CLOSE SPLASH GUARD IF APPLICABLE
7. CUT COOLANT PUMPON IF APPLICABLE

   NOTE: DO NOT CUT COOLANT ON UNTIL WHEEL TOUCHES WORKPIECE AS IT MAKES IT DIFFICULT TO DETERMINE ACTUAL CONTACT BETWEEN WHEEL AND WORKPIECE
8. TURN CROSS FEED OUT .001" (INTO WORKPIECE)
9. FEED GRINDING WHEEL INTO HOLE BY TURNING TABLE FEED COUNTER CLOCKWISE
10. FEED UNTIL TABLE REACHES LEFT DOG
11. REVERSE TABLE FEED DIRECTION UNTIL RIGHT TABLE DOG IS REACHED

    CAUTION: DO NOT CHANGE CROSS FEED SETTING UNTIL AT LEAST ONE COMPLETE CYCLE HAS BEEN MADE

    NOTE: CYCLE MAY BE REPEATED TWO OR THREE TIMES BEFORE CHANGING SETTING
12. REPEAT PROCEDURE UNTIL HOLE HAS BEEN CLEANED UP
13. CLEAR GRINDING WHEEL FROM HOLE

    NOTE: RIGHT TABLE DOG WILL HAVE TO BE MOVED
14. TURN COOLANT OFF IF USING
15. TURN HEADSTOCK SPINDLE OFF
16. TURN GRINDING SPINDLE OFF
17. WIPE INSIDE OF HOLE CLEAN AND DRY WITH RAG

3. INSPECT TAPER AND DIAMETER OF HOLE

1. FOLLOW THE SAME PROCEDURE AS IN X-H-2a(TS) STEP 3. SEE FIG. 2
2. CONTINUE GRINDING PROCEDURE UNTIL COMPLETION OF GRINDING OPERATION

   NOTE: HOLD SPECIFIED DIMENSIONS AS PER DRAWING. 1.2310" ON LARGE DIAMETER AND 1.0200" ON SMALL DIAMETER

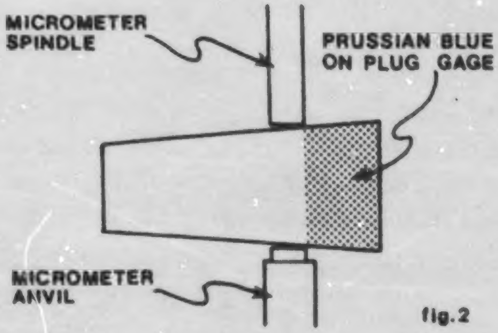


fig.2

4. SECURE MACHINE	1. REMOVE WORKPIECE NOTE: WITH SMALL HONE BURR EDGES 2. REMOVE AND CLEAN EQUIPMENT TO BE STORED NOTE: PLACE IN PROPER STORAGE PLACE 3. CLEAN AND WIPE MACHINE AS PER X-A-1c(TS)

SKETCHES: DRAWING #14: TAPER RING GAGE

REFERENCES: REF. #3, PP. 297-310
REF. #4, PP. 446-470

MORSE TAPER SLEEVE

MACHINE SHOP

ENGINE LATHE 13

VERTICAL MILLING MACHINE 11

CYLINDRICAL GRINDER 6

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, OPERATE DESIGNATED MACHINES, AND CONSTRUCT A MORSE TAPER SLEEVE ACCORDING TO SPECIFICATIONS

CHECKING STANDARDS

1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS
2. HOLD ALL SURFACES TO PRECISION FINISH
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT
5. MAINTAIN A SAFETY ATTITUDE

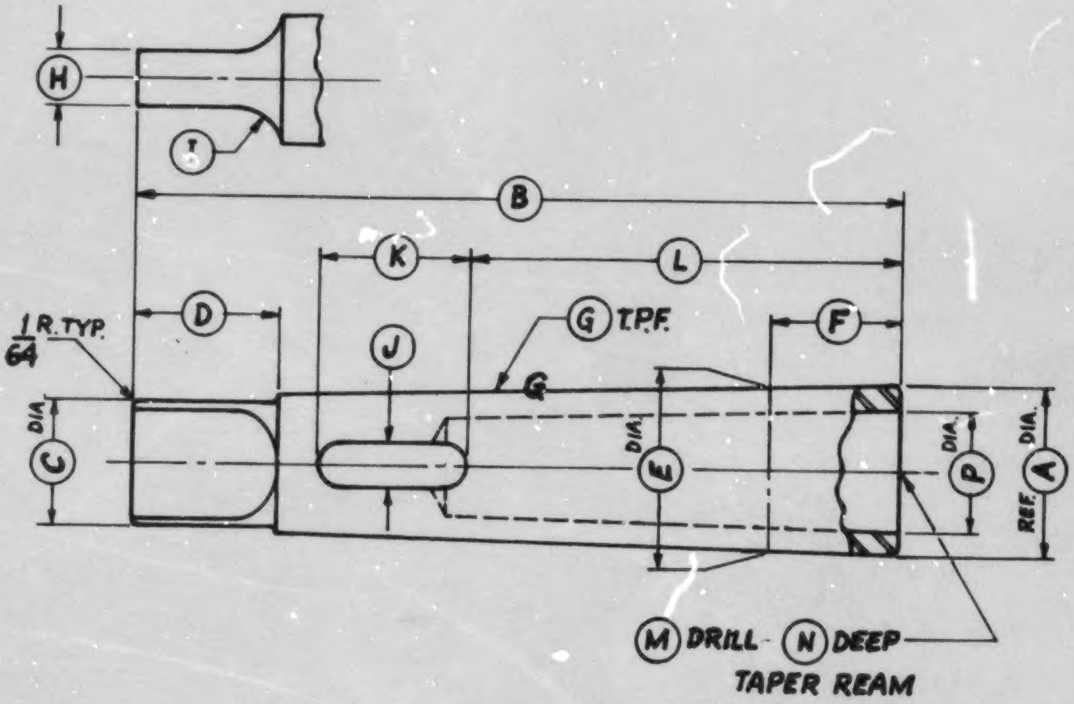
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A. AND MCCARTHY, WILLARD J., METALWORK TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR #2 MORSE INSIDE TAPER AND #3 MORSE OUTSIDE TAPER. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY



DET. NO.	MORSE TAPER	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P
1	1-INSIDE 2-OUTSIDE	.731	$3\frac{9}{16}$	$\frac{17}{32}$	$\frac{11}{16}$	.700	$\frac{5}{8}$	.599	$\frac{1}{4}$	$\frac{1}{4}$	.213	$\frac{3}{4}$	$2\frac{1}{16}$	$\frac{23}{64}$	$2\frac{3}{16}$	.475
2	1-INSIDE 3-OUTSIDE	950	$3\frac{15}{16}$	$\frac{17}{32}$	$\frac{17}{32}$	.938	$\frac{1}{4}$	.602	$\frac{5}{16}$	$\frac{9}{32}$	.213	$\frac{3}{4}$	$2\frac{1}{16}$	$\frac{3}{8}$	$2\frac{3}{16}$	.475
3	2-INSIDE 3-OUTSIDE	.976	$4\frac{7}{16}$	$\frac{23}{32}$	$\frac{27}{32}$	.938	$\frac{3}{4}$	.602	$\frac{5}{16}$	$\frac{9}{32}$	.260	$\frac{7}{8}$	$2\frac{1}{2}$	$\frac{9}{16}$	$2\frac{5}{8}$	.700
4	2-INSIDE 4-OUTSIDE	1.244	$4\frac{7}{8}$	$\frac{23}{32}$	$\frac{15}{16}$	1.231	$\frac{1}{4}$	.623	$\frac{15}{32}$	$\frac{5}{16}$	.260	$\frac{7}{8}$	$2\frac{1}{2}$	$\frac{9}{16}$	$2\frac{5}{8}$	.700
5	3-INSIDE 4-OUTSIDE	1.270	$5\frac{3}{8}$	$\frac{31}{32}$	$\frac{15}{16}$	1.231	$\frac{3}{4}$	.623	$\frac{15}{32}$	$\frac{5}{16}$	.322	$1\frac{3}{16}$	$3\frac{1}{16}$	$\frac{49}{64}$	$3\frac{1}{4}$	.938

DRAWING NO. 15

MORSE TAPER SLEEVE

TOLERANCES UNLESS OTHERWISE NOTED

LATHE JOB NO. 13
MILLING JOB NO. 11
CYL. GRINDER. JOB NO. 6

MATERIAL: TOOL STEEL
FINISH: GRIND & REAM
SCALE: FULL SIZE

FRACTIONS - ± 1/64"
DECIMAL - ± .005"
ANGLES - ± 1/4°

JOB SHEET
ON
ENGINE LATHE

VII-N-1(J)

JOB: MORSE TAPER SLEEVE

MATERIALS: 1 PIECE - 1" X 4 1/2" ROUND TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, INDEPENDENT CHUCK, FACING TOOL, CENTER DRILL, TAILSTOCK DRILL CHUCK AND KEY, TURNING TOOL, 0-1" MICROMETER, 6" RULE, FACE PLATE, DEAD CENTER, LIVE CENTER, 1" DRIVE DOG, 9/16" DRILL, BORING TOOL, INSIDE CALIPER, DIAL INDICATOR, TAPER SLEEVE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, PP. 36-1 TO 36-44; REF. #2, LATHES, PP. 462-494. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES

PROCEDURES AND/OR TASKS:

VII-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-C-1(TS)	SET UP, FACE, AND CENTER DRILL BOTH ENDS NOTE: HOLD 4 7/16" LENGTH ON WORKPIECE
VII-L-1(TS)	SET UP INDEPENDENT CHUCK AND INDICATE WORKPIECE TRUE NOTE: LEAVE 1" PROTRUDING FROM END OF CHUCK
VII-B-1d(TS)	SET UP AND TURN 23/32" DIAMETER NOTE: HOLD 27/32" LENGTH. REMOVE INDEPENDENT CHUCK AND MOUNT FACE PLATE
VII-B-1g(TS)	SET UP WORKPIECE BETWEEN CENTERS NOTE: LATHE DOG WILL BE FASTENED TO 23/32" MACHINED END
VII-B-1h(TS)	SET UP AND TURN #3 MORSE TAPER NOTE: HOLD .950" ± .002" ON O.D., 3/4" FROM END, OR DIMENSION "F" AS PER DRAWING NOTE: .950" WILL LEAVE .012" FOR CYLINDRICAL GRINDING
REMOVE FACE PLATE AND LIVE CENTER	
VII-B-1g(TS)	MOUNT TURNED #3 MORSE TAPER IN HEAD-

	STOCK SPINDLE
VII-D-1(TS)	SET UP AND DRILL 9/16" HOLE 2 5/8' DEEP
VII-M-1(TS)	SET UP AND BORE I.D. TO #2 MORSE TAPER NOTE: HOLD .690" ± .002" AT LARGE END. THIS LEAVES .010" FOR REAMING
VII-D-1a(TS)	SET UP AND REAM HOLE #2 MORSE TAPER NOTE: HOLD .700" ± .002" FOR FINISHED SIZE ON LARGE END
VII-A-1c(TS)	CLEAN MACHINE

HOLD FOR SPECIAL MANDREL AND ROUTE TO MILLING MACHINE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK FOR CORRECT SETUP
3. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

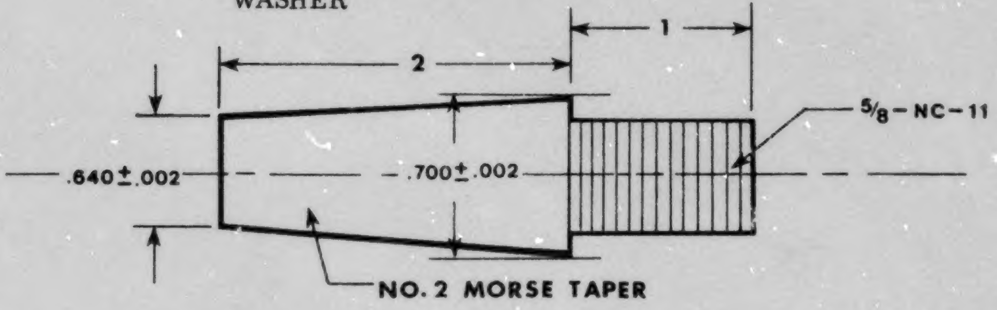
VII-N-2(J)

JOB SHEET
ON
ENGINE LATHE

JOB: SPECIAL #2 MORSE TAPER MANDREL

MATERIALS: 3/4" X 3" ROUND TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, INDEPENDENT CHUCK, DIAL INDICATOR, TAILSTOCK DRILL CHUCK AND KEY, CENTER DRILL, FACE PLATE, LIVE CENTER, DEAD CENTER, 0-1" MICROMETER, 6" RULE, TURNING TOOL, TAPER SLEEVE (IF NECESSARY), CENTER GAGE, THREADING TOOL, 5/8" - NC - 11 NUT, 5/8" WASHER



GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, LATHES, PP. 36-1 TO 36-44; REF. #2, LATHES, PP. 462 - 494. CHECK WITH INSTRUCTOR BEFORE BEGINNING JOB

PROCEDURE AND/OR TASKS:

VII-A-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-C-1(TS)	SET UP, FACE AND CENTER DRILL BOTH ENDS
VII-B-1g(TS)	SET UP WORKPIECE BETWEEN CENTERS
VII-G-1(TS)	SET UP AND TURN #2 MORSE TAPER. NOTE: HOLD DIMENSIONS AS PER DRAWING .700" LARGE DIAMETER: .640" SMALL DIAMETER: 2" LONG
VII-N-2(TS)	SET UP AND CUT 5/8" - NC - 11 THREAD 1" LONG. ROUTE MANDREL AND SLEEVE TO VERTICAL MILLING MACHINE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION

CHECK POINTS: (CONT'D.)

2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT AND STANDARDS

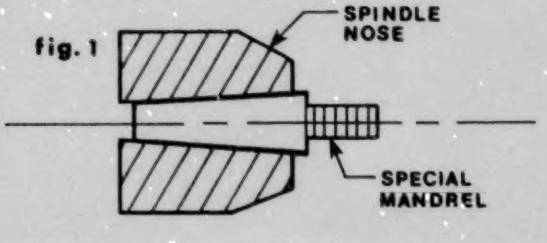
TASK: SET UP MANDREL AND TURN 5/8" - NC - 11 THREADS

JOB: MORSE TAPER SLEEVE

TRADE: MACHINIST

TOOLS AND EQUIPMENT: ENGINE LATHE, 0-1" MICROMETER, 6" RULE, TURNING TOOL, TAPER SLEEVE, CENTER GAGE, THREADING TOOL, 5/8" WASHER, 5/8" - NC - 11 NUT

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORKPIECE fig. 1 	1. WIPE SPINDLE OF LATHE CLEAN 2. INSPECT AND REMOVE ANY BURRS ON MANDREL 3. INSERT MANDREL INTO LATHE SPINDLE NOTE: IF SPINDLE IS TOO LARGE, INSERT SLEEVE TO FIT SPINDLE AND MANDREL SEE FIG. 1
2. SET UP TOOLING AND CUT 5/8" - NC - 11 THREAD	REFER TO: VII-I-1(TS) NOTE: HOLD 1" LENGTH ON THREADS
3. REMOVE MANDREL FROM SPINDLE OR SLEEVE	1. PLACE WASHER ON THREADED END 2. SCREW 5/8" - NC - 11 NUT ON THREADS 3. TIGHTEN NUT AGAINST WASHER AND MANDREL SHOULDER NOTE: THIS WILL CAUSE MANDREL TO POP FREE NOTE: SHOULD SLEEVE NOT BE USED, A KNOCK OUT BAR WILL REMOVE THE SPECIAL MANDREL
4. INSPECT MANDREL	1. DEBURR ALL EDGES 2. CHECK DIMENSIONS TO DRAWING SPECIFICATIONS ROUTE TO MILLING MACHINE

SKETCHES: DRAWING AS ATTACHED TO JOB SHEET VII-N-2(J)

REFERENCES: REF. #1, PP. 36-1 TO 36-44
REF. #2, PP. 462-494

IX-K-1 (J)

JOB SHEET
ON
VERTICAL MILLING MACHINE

JOB: MORSE TAPER SLEEVE

MATERIALS: MORSE TAPER SLEEVE AS MACHINED ON LATHE

TOOLS AND EQUIPMENT: VERTICAL MILLING MACHINE, DIVIDING HEAD AND TAILSTOCK CENTER, SPECIAL MANDREL WITH #2 MORSE TAPER, 1" END MILL WITH 9/32" RADII, END MILL ADAPTOR, DRILL CHUCK AND ADAPTOR, 7/32" DRILL, 1/4" END MILL AND ADAPTOR, 0-1" MICROMETER, 6" RULE, LAYOUT INK, SCRIBE, PRICK PUNCH, HAMMER, 5/8" WASHER AND 5/8" - NC - 11 NUT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, MILLING MACHINES, PP. 38-1 TO 38-38; REF. #3, MILLING MACHINES, PP. 229 TO 283. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

IX-A-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-B-1 (TS)	SET UP DIVIDING HEAD
IX-B-1a (TS)	SET UP WORKPIECE IN DIVIDING HEAD SPINDLE
IX-B-1b (TS)	SET UP END MILL ADAPTOR AND 1" END MILL
IX-B-1c (TS)	MACHINE FIRST SIDE OF TANG
IX-B-1d (TS)	ROTATE 180° AND MACHINE SECOND SIDE OF TANG. NOTE: HOLE REF. H, 5/16" AND REF. D, 27/32".
	REMOVE END MILL AND ADAPTOR
IX-K-1 (TS)	LAY OUT AND DRILL RADII OF WORKPIECE SLOT
IX-K-1 (TS)	SET UP AND MILL 1/4" SLOT
IX-A-1c (TS)	CLEAN MACHINE
	ROUTE TO CYLINDRICAL GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

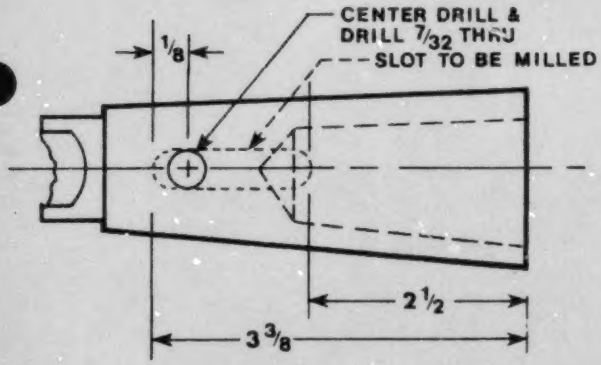
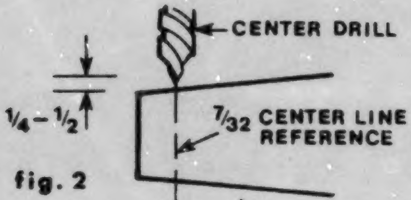
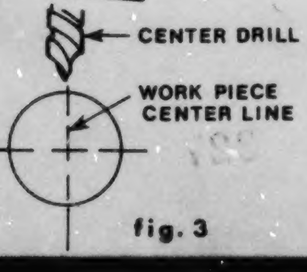
TASK: LAY OUT AND MILL SLOT

JOB: MORSE TAPER SLEEVE

TRADE: MACHINIST

TOOLS AND MATERIALS: LAYOUT INK, SCRIBE, 6" RULE, COMBINATION SQUARE, SURFACE GAGE, PRICK PUNCH, HAMMER, #5 CENTER DRILL, DRILL CHUCK, 1/4" END MILL, SQUARE, END MILL HOLDER, 7/32" DRILL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAY OUT SLOT fig. 1  CENTER DRILL & DRILL 7/32 THRU SLOT TO BE MILLED 1/8 2 1/2 3 3/8	1. APPLY LAYOUT INK TO AREA WHERE LAYOUT IS TO BE MADE 2. MEASURE 3 3/8" FROM LARGE END OF WORKPIECE AND SCRIBE REFERENCE LINE. NOTE: SEE REF. L + REF. K ON PRINT 3. MEASURE 2 1/2" FROM LARGE END OF WORKPIECE AND SCRIBE REFERENCE LINE. NOTE: SEE REF. L ON PRINT NOTE: THESE REFERENCE LINES ARE THE EXTREME EDGES OF SLOT AND SHOULD BE 7/8". SEE REF. K ON PRINT 4. LAY OUT LINE ON WORKPIECE 1/8" FROM LEFT EDGE OF SLOT. SEE FIG. 1 NOTE: THIS WILL BE THE CENTER FOR 7/32" DRILLED HOLE NOTE: THIS WILL ALLOW FOR FINISHED MILLING OF WIDTH AND RADIUS ON SLOT
2. SET UP AND DRILL 7/32" PILOT HOLE FOR END MILL  fig. 2  fig. 3	1. SET UP DRILL CHUCK IN SPINDLE 2. SET UP #5 CENTER DRILL IN DRILL CHUCK 3. POSITION TABLE SO DRILL CLEARS WORKPIECE BY 1/4" TO 1/2" 4. MOVE LONGITUDINAL AND CROSS TRAVERSE HANDWHEEL UNTIL CENTER DRILL POINT IS LOCATED OVER CENTER LINE OF 7/32" HOLE. SEE SKETCH FIG. 2 5. CENTER WORKPIECE AND CENTER DRILL REFER TO: IX-I-1c(TS) NOTE: CENTER DRILL SHOULD NOW BE CENTERED ON WORKPIECE AS PER SKETCH FIG. 3

6. LOCK VERTICAL, CROSS TRAVERSE, AND LONGITUDINAL FEED
7. SET VERTICAL SPINDLE SPEED. REFER TO CHART, REF. #1, P. 34-10 OR REF. #3, P. 105
8. CENTER DRILL HOLE. NOTE: HOLD 7/32" DIAMETER AND DEPTH SUFFICIENT TO SERVE AS PILOT FOR 7/32" DRILL BIT
9. REPLACE CENTER DRILL WITH 7/32" DRILL. NOTE: IT MAY BE NECESSARY TO LOWER TABLE TO INSERT 7/32" DRILL CAUTION: DO NOT CHANGE CROSS TRAVERSE AND LONGITUDINAL POSITION
10. DRILL 7/32" HOLE THROUGH AS PER SKETCH. CAUTION: DO NOT APPLY HEAVY FEED TO DRILL BIT TO AVOID BREAKAGE OF DRILL OR SLANTED HOLE
11. REMOVE DRILL AND DRILL CHUCK

3. SET UP AND MILL SLOT AS PER DRAWING

1. SET UP 1/4" END MILL AND HOLDER
2. POSITION END MILL. NOTE: END MILL SHOULD BE IN CORRECT POSITION UNLESS MOVEMENT OF TABLE WAS MADE. NOTE: SET FRONT DOG STOP
3. SET VERTICAL SPINDLE SPEED. REFER TO CHART REF. #1, P. 38-16 OR REF. #2, P. 250. NOTE: BE SURE MACHINE IS CUT ON
4. SET FEED. REFER TO CHART, REF. #1, P. 38-16 OR REF. #3, P. 252
5. LOCK SPINDLE QUILL
6. RAISE TABLE UNTIL END MILL DEPTH OF CUT IS ABOUT .125" TO .250" CAUTION: HEAVY FEED OR CUT MAY BREAK END MILL
7. LOCK VERTICAL FEED
8. UNLOCK LONGITUDINAL FEED
9. ENGAGE POWER FEED UNTIL END MILL HAS CUT TO REFERENCE LAYOUT LINE. SEE SKETCH. CAUTION: BE SURE LONGITUDINAL HANDWHEEL IS TURNED IN CORRECT DIRECTION NOTE: SET TRIP DOG TO HOLD 7/8" SLOT LENGTH
10. RETURN WORK TO STARTING POSITION

	11. RELEASE VERTICAL FEED LOCK AND RAISE TABLE 1/4" AS BEFORE 12. REPEAT MILLING PROCEDURE UNTIL SLOT IS MILLED THROUGH WORKPIECE
4. REMOVE WORKPIECE	1. REMOVE WORKPIECE AND MANDREL FROM DIVIDING HEAD. REFER TO: VII-N-2(TS) 2. REMOVE WORKPIECE FROM SLEEVE IF USED. REFER TO: VII-N-2(TS) STEP 3
5. CLEAN MACHINE	REFER TO: VII-A-1c(TS) ROUTE TO CYLINDRICAL GRINDER

SKETCH: DRAWING #15: MORSE TAPER SLEEVE

REFERENCES: REF. #1, PP. 38-1 TO 38-38
REF. #2, PP. 229-283

X-I-1(J)

JOB SHEET
ON
CYLINDRICAL GRINDER

JOB: MORSE TAPER SLEEVE

MATERIALS: MORSE TAPER SLEEVE AS MACHINED ON LATHE AND MILLING MACHINE

TOOLS AND EQUIPMENT: CYLINDRICAL GRINDER, DIAMOND DRESSING TOOL, SPECIAL MANDREL, 0-1" MICROMETER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #1, GRINDING, PP. 33-1 TO 33-15; AND REFERENCE #3, PRECISION GRINDING, PP. 287-309. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

X-A-1(TS)	CHECK MACHINE FOR PROPER WORKING CONDITION
X-A-1a(TS)	DRESS GRINDING WHEEL
X-C-1(TS)	SET UP MANDREL AND WORKPIECE
X-C-1a(TS)	SET UP AND GRIND #3 MORSE TAPER NOTE: HOLD .938"±.0002" ON O.D. 3/4" FROM END. SEE REF. F ON DRAWING

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

MACHINE SHOP SINGLE-POINT SCRIBER

ENGINE LATHE 14

HORIZONTAL MILLING MACHINE 12

BENCH 9

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A SINGLE-POINT SCRIBER ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAY OUT ACCORDING TO SPECIFICATIONS.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRESCRIBED FINISH.
6. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES
7. MAINTAIN SAFE WORKING HABITS.

REFERENCES

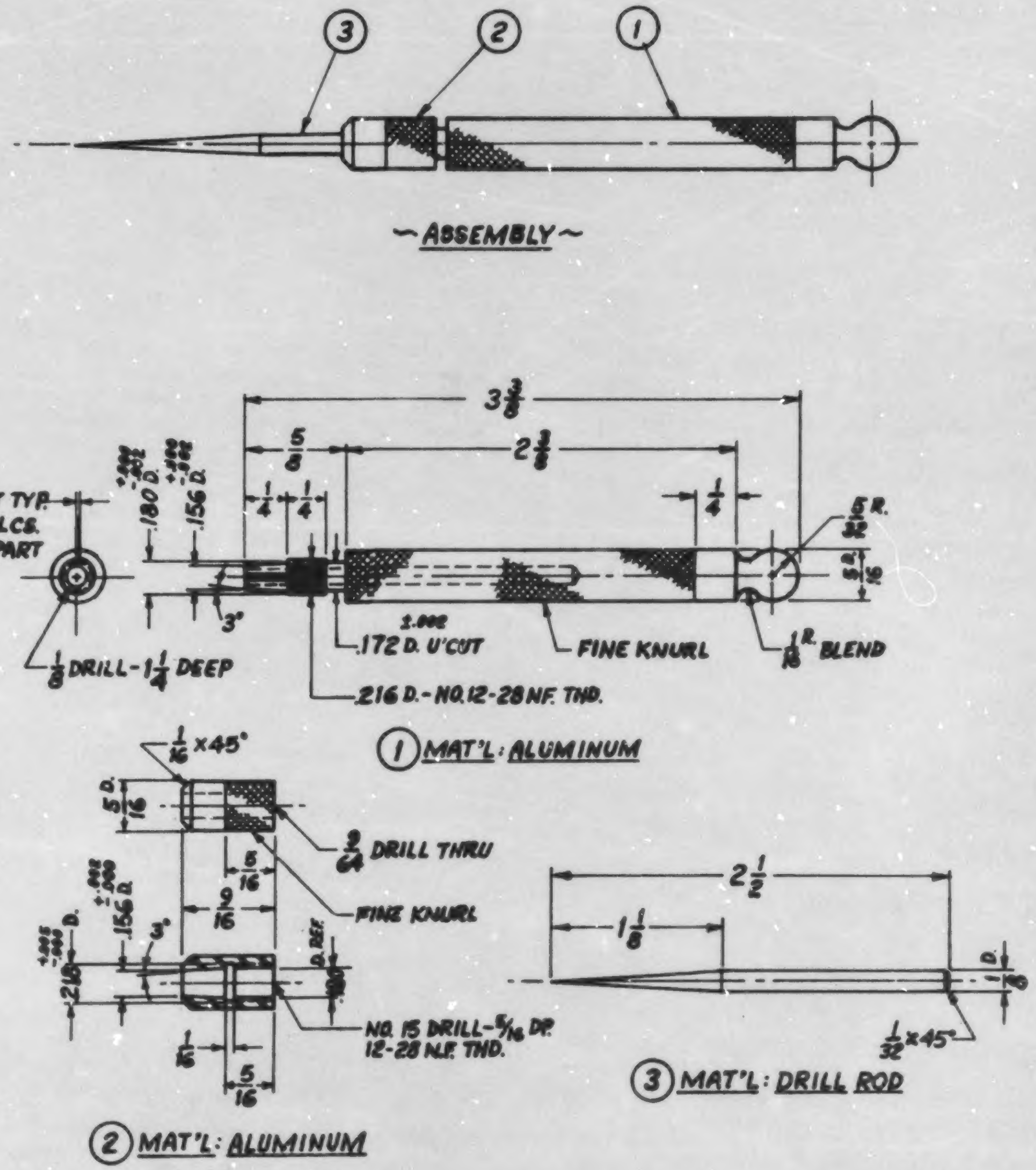
REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A., AND McCARTHY, WILLARD J., METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

REF. #4, McCARTHY, WILLARD J., AND SMITH, ROBERT E., MACHINE TOOL TECHNOLOGY.

NOTE: IN THIS JOB THE STUDENT WILL GET ALL NECESSARY MATERIALS FROM SUPPLY PRIOR TO STARTING TASKS FOR CONSTRUCTION OF THIS MULTI-PART JOB. THE STUDENT IS CHARGED WITH KEEPING TRACK OF EACH AND ALL PARTS. THE JOB AND TASK SHEETS ARE WRITTEN FOR THE COMPLETION OF EACH PART BEFORE PROCEEDING TO THE NEXT PART. IN THIS JOB, TASKS THAT HAVE BEEN PERFORMED IN THE PAST WILL BE CONSIDERED AS WITHIN THE TASK OF CONSTRUCTING THE PART. REFERENCE WILL BE GIVEN TO PREVIOUS TASKS THE STEP REFERS TO, WITH KEY POINTS STUDENTS SHOULD BE AWARE OF. TASKS THAT HAVE NOT BEEN PERFORMED PREVIOUSLY WILL BE WRITTEN UP AS SUCH.


3
2
1
~ASSEMBLY~
3 3/8
5/8
2 3/8
1/4
1/4
1/4
1/32 SLOT TYP. (4) PLCS. 90° APART
+.002 -.002 .180 D.
+.002 -.002 .156 D.
3°
5/32 R.
5/16 D.
1/8 DRILL - 1 1/4 DEEP
±.002 .172 D. U'CUT
FINE KNURL
1/16 R. BLEND
.216 D. - NO. 12-28 NF. THD.
1 MAT'L: ALUMINUM
1/16 × 45°
5/16 D.
9/64 DRILL THRU
5/16
9/16
FINE KNURL
+.002 -.000 .156 D.
+.005 -.000 .216 D.
3°
.180 D. REF.
NO. 15 DRILL - 5/16 DP.
12-28 N.F. THD.
1/16
5/16
2 MAT'L: ALUMINUM
2 1/2
1 1/8
1/8 D.
1/32 × 45°
3 MAT'L: DRILL ROD

DRAWING NO. 16	SINGLE POINT SCRIBER	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 14 MILLING JOB NO. 12 BENCH JOB NO. 9	MATERIAL: AS NOTED FINISH: POLISH SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-O-1 (J)

JOB SHEET
ON
ENGINE LATHE

JOB: SINGLE-POINT SCRIBER

MATERIAL: ONE PIECE 5/16" DIAMETER x 3 7/16" ALUMINUM

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, #2 CENTER DRILL, FACING TOOL, TAILSTOCK DRILL CHUCK, LIVE CENTER, KNURLING TOOL, TURNING TOOL, 1/8" CUT-OFF TOOL, VERNIER CALIPERS, 6" RULE, 60° THREADING TOOL, 1/8" DRILL, CENTER GAGE, 1/16"^{R} GROOVE TOOL, 0-1" MICROMETER, ROUND NOSE TURNING TOOL, 5/32" RADIUS GAGE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #3, LATHE, PP. 135-208; REF. #4, LATHE, PP. 217-285; CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:

VII-B-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITIONS
VII-O-1 (TS)	MACHINE HANDLE ON LATHE ROUTE TO MILLING MACHINE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITIONS
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-O-1 (TS)

TASK:	MACHINE HANDLE
JOB:	SINGLE-POINT SCRIBER
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, 0-1" MICROMETER, TAILSTOCK DRILL CHUCK, #2 CENTERDRILL, FACING TOOL, LIVE CENTER, KNURLING TOOL, TURNING TOOL, 1/8" CUT-OFF TOOL, VERNIER CALIPERS, 6" RULE, 60° THREADING TOOL, 1/8" DRILL, 1/16"^{R} GROOVING TOOL, ROUND NOSE TOOL, MILL FILE, #14 DRILL, CENTER GAGE, 5/32" RADIUS GAGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK MATERIAL	1. SET UP COLLET ATTACHMENT WITH 5/16" COLLET. REFER TO VII-A-1a (TS)
	2. POSITION WORKPIECE IN COLLET NOTE: STOCK EXTENDED OUT FROM COLLET ABOUT 7/8"
2. FACE AND CENTERDRILL END	1. REFER TO VII-C-1 (TS) NOTE: FACE TO CLEAN UP
	2. CENTERDRILL WITH #2 CENTERDRILL NOTE: DO NOT FEED CENTERDRILL TO FULL BODY DIAMETER. HOLD 1/8"^{D} ON BEVELED HOLE
3. DRILL 1/8" HOLE	1. REMOVE CENTERDRILL
	2. CHUCK 1/8" DRILL IN TAILSTOCK CHUCK
	3. DRILL HOLE 1 1/4" DEEP NOTE: REFER TO VII-D-1 (TS)
	4. REMOVE DRILL BIT AND CHUCK FROM TAILSTOCK SPINDLE
4. KNURL HANDLE	1. LOOSEN COLLET
	2. SLIDE WORKPIECE OUT TO CLEAR CHUCK WITH KNURLING TOOL NOTE: ABOUT 2 7/8" FROM END OF WORKPIECE
	3. LAY OUT LENGTH OF KNURL 2 3/4" FROM END OF WORKPIECE
	4. KNURL WORKPIECE. SEE VII-C-1a (TS) NOTE: USE FINE PITCH KNURL

5. TURN COLLET END	1. SET UP TURNING TOOL 2. TURN DIAMETER. HOLD $.216'' \, {}^{+.000}_{-.002}$ DIAMETER 5/8" FROM END. REFER TO VII-A-1a (TS) 3. REMOVE TURNING TOOL
6. TURN RELIEF FOR THREAD	1. SET UP 1/8" PARTING TOOL 2. POSITION PARTING TOOL 1/2" FROM END OF WORKPIECE AS PER DRAWING 3. TURN DIAMETER. SEE VII-F-1b(TS) NOTE: HOLD .172 ± .002
7. TURN #12-28 THREAD	1. SET GEAR BOX FOR 28 PITCH THREAD 2. SET MACHINE SPINDLE TO SLOW SPEED NOTE: ABOUT 1/4 TURNING SPEED 3. SET UP THREADING TOOL 4. TURN 28 THREADS PER INCH AS PER DRAWING. SEE VII-I-1 (TS) 5. CLEAN AND INSPECT THREADS 6. REMOVE THREADING TOOL
8. TURN TAPER ON COLLET END	1. SET UP TURNING TOOL 2. SET TAPER ATTACHMENT TO REQUIRED TAPER 3. TURN TAPER. SEE VII-B-1h (TS) NOTE: HOLD $.180'' \, {}^{+.000}_{-.002}$ DIAMETER AT LARGE END x 1/4" SPECIFIED LENGTH NOTE: A 1/32" FLAT RELIEF MAY BE NECESSARY AT THE LARGE END OF TAPER. FILE OR GRIND RELIEF
9. TURN 5/32"^{R} SPHERICAL END	1. LOOSEN COLLET 2. REVERSE ENDS OF WORKPIECE NOTE: THREADED END POSITIONED IN CHUCK 3. LEAVE 3/4" PROTRUDING FROM COLLET CHUCK 4. SET UP 1/16" GROOVING TOOL WITH 1/16 SPHERICAL RADIUS ON END 5. TURN RELIEF. SEE VII-F-1b(TS) NOTE: HOLD 3/16" DIAMETER 3/8" FROM END OF WORKPIECE NOTE: 3/8" LENGTH INCLUDES RELIEF WIDTH 6. SET UP ROUND NOSE TURNING TOOL 7. TURN 5/16"^{R} SPHERICAL BALL ON END SEE VII-J-1 (TS)

8. FILE OR POLISH TO REMOVE ANY TOOL MARKS
9. INSPECT WITH RADIUS GAGE
10. REMOVE FROM MACHINE
11. ROUTE MILLING MACHINE

SKETCHES: DRAWING #16; SINGLE-POINT SCRIBER

REFERENCES: REF. #3, PP. 135-208
REF. #4, PP. 217-291

IX-L-1 (J)

JOB SHEET
ON
MILLING MACHINE

JOB: SINGLE-POINT SCRIBER

MATERIALS: DOUBLE-POINT SCRIBER HANDLE AS MACHINED ON THE LATHE

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, ARBOR AND SPACING COLLARS, 1/32" SLITTING SAW, DIVIDING HEAD, UNIVERSAL CHUCK, MILL FILE, 6" RULE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REFERENCE #3, MILLING MACHINE, PP. 317-403. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASK:
IX-A-1 (TS) CHECK MACHINE FOR PROPER OPERATING CONDITION
IX-L-1 (TS) MILL 1/32" SLOTS IN HANDLE

BURR AND HOLD PARTS FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS.

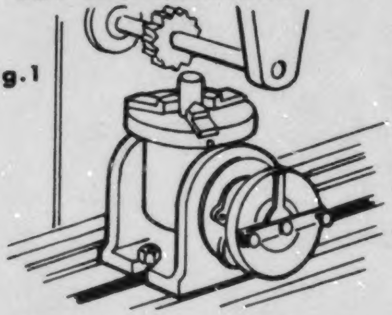
1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR MACHINE TOOLS, EQUIPMENT, SUPPLIES AND STANDARDS
5. SAFE WORKING HABITS

TASK SHEET

IX-L-1 (TS)

TASK:	MILL 1/32" SLOTS IN HANDLE
JOB:	SINGLE-POINT SCRIBER
TRADE:	MACHINIST
TOOLS AND MATERIALS:	HORIZONTAL MILLING MACHINE, DIVIDING HEAD, ARBOR AND SPACING COLLARS, UNIVERSAL CHUCK, 1/32" SLITTING SAW, 6" RULE, MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP DIVIDING HEAD	1. CLEAN MILLING MACHINE TABLE 2. FASTEN DIVIDING HEAD TO TABLE SEE IX-B-1 (TS) 3. PLACE UNIVERSAL CHUCK ON SPINDLE OF DIVIDING HEAD
2. SET SPINDLE SPEED AND TABLE FEED	REFER TO CHART REF. #1, PP. 36-16 AND 36-17; REF. #2, PP. 548-550
3. SET UP WORKPIECE fig.1 	1. CHUCK HANDLE IN UNIVERSAL CHUCK NOTE: ONLY THREADED END OF HANDLE PROTRUDES FROM CHUCK JAWS CAUTION: PROTECT KNURL BY WRAPPING WITH BRASS OR ALUMINUM SHIM STOCK 2. ROTATE DIVIDING HEAD TO 90°; SEE FIGURE 1 NOTE: REFER TO: IX-D-1 (TS)
4. SET UP SLITTING SAW	1. MOUNT SLITTING SAW ON ARBOR. SEE IX-E-1a (TS) 2. CENTER SLITTING SAW OVER WORKPIECE. SEE IX-I-1c (TS) NOTE: LOCK TABLE 3. SET STOPS. SEE IX-I-1c (TS) 4. SET SPINDLE AND FEED DIRECTION
5. ROUGH CUT FIRST SLOT	1. RAISE TABLE UNTIL CUTTER TOUCHES WORKPIECE 2. SET VERTICAL HAND CRANK DIAL ON "O" 3. CLEAR CUTTER FROM WORKPIECE

	4. RAISE TABLE TO DPETH OF FIRST CUT NOTE: DEPTH MAY VARY, ABOUT .200" IS RECOMMENDED 5. ENGAGE FEED NOTE: IF MACHINE VIBRATES INDICATING OVERLOAD, DECREASE DEPTH OF CUT 6. COMPLETE FIRST CUT 7. MOVE CUTTER BACK TO STARTING POSITION. REFER TO: IX-I-1c (TS)
6. ROUGH CUT SECOND SLOT	1. INDEX DIVIDING HEAD ONE QUARTER REVOLUTION NOTE: THIS WILL BE 10 COMPLETE TURNS ON THE CRANK 2. FOLLOW SAME PROCEDURE AS IN STEP 1. REFER TO IX-I-1c (TS) 3. ROUGH CUT THIRD AND FOURTH SLOTS FOLLOWING SAME PROCEDURE AS IN 1 AND 2
7. FINISH CUT SLOTS	1. RAISE TABLE .1125" 2. LOCK TABLE 3. CUT EACH SLOT AS IN STEPS 5 AND 6 NOTE: HOLD 5/16" DEPTH 4. SECURE MACHINE 5. REMOVE WORKPIECE 6. BURR WORKPIECE WITH FILE HOLD FOR ASSEMBLY

SKETCHES: DRAWING #16: SINGLE-POINT SCRIBER

REFERENCES: REF. #3, PP. 229-285
REF. #4, PP. 317-403

JOB SHEET
ON
ENGINE LATHE

VII-O-2 (J)

JOB:	SINGLE-POINT SCRIBER
MATERIAL:	ONE PIECE 5/16" DIAMETER X 1 1/2" ALUMINUM ROUND NOTE: THIS PROVIDES 3/4" WASTE FOR CHUCKING
TOOLS AND EQUIPMENT:	ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, FACING TOOL, TURNING TOOL, 5/32" DRILL, TAILSTOCK DRILL CHUCK, #14 DRILL, #2 CENTERDRILL, SPECIAL INTERNAL GROOVING TOOL, SPECIAL 6° TAPERED REAMER, 0-1" MICROMETER, #12-28 TAPER TAP, #12-28 BOTTOM TAP, TAP WRENCH, INSIDE CALIPERS, MILL FILE, 6" RULE, 1/8" CUT-OFF TOOL
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #3, LATHE, PP. 217-285. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES OR STARTING SPECIAL MACHINING OPERATIONS.
PROCEDURE AND/OR TASK:	VII-B-1 (TS) CHECK MACHINE FOR PROPER OPERATING CONDITIONS VII-O-2 (TS) MACHINE COLLET NUT ON LATHE HOLD FOR ASSEMBLY
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS. 1. CHECK MACHINE FOR PROPER OPERATING CONDITIONS 2. CHECK MACHINE FOR PROPER SETUP 3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS 4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS 5. CHECK WITH INSTRUCTOR ON PROCEDURE IN USE OF SPECIAL TOOLING

TASK SHEET VII-O-2 (TS)

TASK: MACHINE COLLET NUT ON LATHE

JOB: SINGLE-POINT SCRIBER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, FACING TOOL, TURNING TOOL, 5/32" DRILL, TAILSTOCK DRILL CHUCK, #14 DRILL, #2 CENTER DRILL, SPECIAL INTERNAL GROOVING TOOL, SPECIAL TAPERED REAMER, 0-1" MICROMETER, #12-28 TAPER TAP, #12-28 BOTTOMING TAP, TAP WRENCH, INSIDE CALIPERS, MILL FILE, 6" RULE, 1/8" CUT-OFF TOOL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK MATERIAL	1. SET UP COLLET ATTACHMENT WITH 5/16" COLLET. SEE VII-A-1a (TS) 2. POSITION WORKPIECE IN COLLET NOTE: STOCK EXTENDED OUT FROM COLLET ABOUT 7/8"
2. FACE AND CENTERDRILL END	1. FACE TO CLEAN UP ONLY 2. CENTERDRILL WITH #2 CENTERDRILL. REFER TO VII-C-1 (TS) NOTE: HOLD MAXIMUM 9/64"^{D} ON BEVELED HOLE
3. KNURL COLLET	1. SET UP KNURLING TOOL NOTE: USE FINE PITCH KNURL 2. LAY OUT LENGTH OF KNURL NOTE: LAY OUT LINE 1/4" FROM END OF WORKPIECE AS PER DRAWING 3. KNURL WORKPIECE. SEE VII-C-1a (TS) 4. REMOVE KNURLING TOOL
4. TURN 1/16" x 45° BEVEL	REFER TO: VII-F-1a(TS)
5. DRILL 9/64" HOLE	1. SET UP TAILSTOCK DRILL CHUCK WITH 9/64" DRILL 2. DRILL HOLE. REFER TO: VII-D-1 (TS) NOTE: DRILL THROUGH 3. REMOVE 9/64" DRILL BIT
6. CUT OFF COLLET	1. SET UP 1/8" PARTING TOOL 2. POSITION CARRIAGE AND LOCK

NOTE: HOLD 5/8" LENGTH
3. CUT OFF WORKPIECE. REFER TO: VII-A-1b (TS)

7. FACE COLLET

1. SET UP CHAMFERED END IN COLLET
NOTE: CHUCK ON UNKNURLED SURFACE
2. FACE END. REFER TO: VII-C-1 (TS)
NOTE: HOLD 9/16" LENGTH

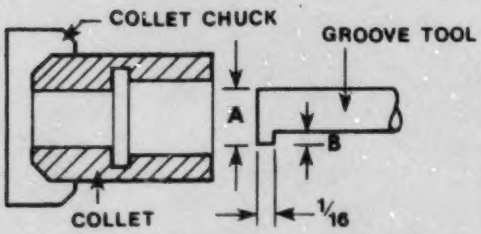
8. DRILL TAP HOLE

1. SET UP TAILSTOCK DRILL CHUCK
2. CHUCK #15 TAP DRILL IN CHUCK
3. DRILL HOLE. REFER TO: VII-D-1 (TS)
NOTE: HOLD 5/16" DEEP

9. CUT 1/16" INTERNAL GROOVE

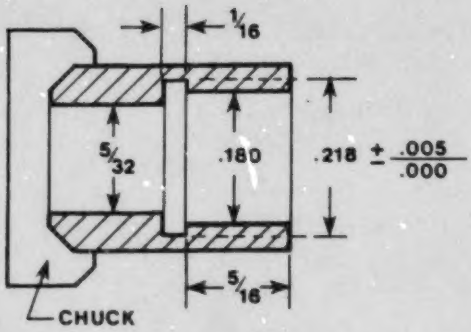
1. SET UP 1/16" SPECIAL GROOVING TOOL
NOTE: SPECIAL TOOL CAN BE MADE FROM SMALL BORING BAR, DRILL ROD, BROKEN TAP, OR ROUND LATHE TOOL
NOTE: METHOD OF HOLDING TOOL WILL BE DETERMINED BY TYPE OF STOCK MADE FROM. SEE FIGURE 1 FOR DESIGN
2. POSITION GROOVING TOOL ON CENTER INTO HOLE
NOTE: HOLD 5/16" FROM END OF WORKPIECE. SEE FIGURE 2
NOTE: LOCK CARRIAGE
3. TURN CROSS SLIDE KNOB COUNTERCLOCKWISE UNTIL GROOVING TOOL TOUCHES SIDE OF HOLE
NOTE: TURN SPINDLE ON PRIOR TO FEEDING TOOL OUT
4. SET CROSS FEED COLLAR ON "O"
5. HAND FEED GROOVING TOOL BY TURNING CROSS FEED COUNTERCLOCKWISE. SEE VII-G-1b (TS)
NOTE: FEED TOOL OUT .020". HOLD SPECIFIED THREAD RELIEF SIZE .218" $^{+.005}_{-.000}$. SEE FIGURE 2
6. INSPECT GROOVE DIAMETER
NOTE: 1/16" WIDTH IS NOT CRITICAL
7. REMOVE GROOVING TOOL

fig. 1 **CUT 1/16 INTERNAL THREAD RELIEF**



A NOT TO EXCEED .180
B NO LESS THAN .025

fig. 2



10. REAM TAPERED HOLE

1. SET UP TAILSTOCK DRILL CHUCK
2. CHUCK SPECIAL REAMER

   NOTE: SEE FIGURE 3 FOR SKETCH OF REAMER

   NOTE: SPECIAL REAMER CAN BE MADE FROM OLD REAMER, DRILL BIT, END MILL, OR TOOL STEEL. HOLD TAPER DIMENSIONS WHEN MAKING
3. SET SPINDLE SPEED ABOUT 150 RPM
4. LOCK TAILSTOCK
5. FEED REAMER INTO HOLE SLOWLY

   NOTE: HOLD 1/4" DEPTH AS PER SKETCH

   NOTE: LARGE DIAMETER SHOULD NOT EXTEND PAST THREAD RELIEF
6. REMOVE REAMER AND DRILL CHUCK

fig. 3

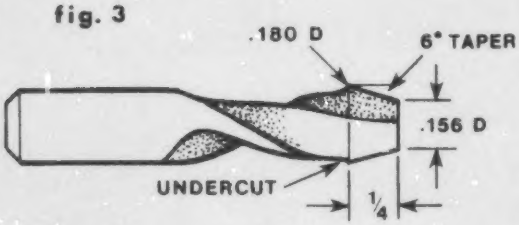
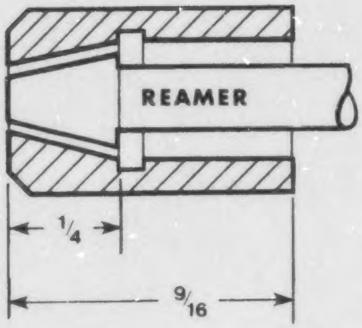


fig. 4

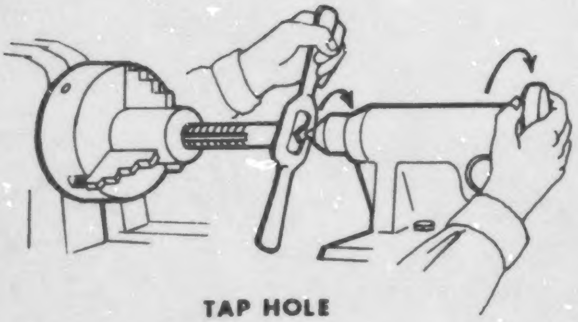


11. TAP COLLET WITH TAPER TAP

1. PLACE LIVE CENTER IN TAILSTOCK
2. PLACE #12-28 TAPER TAP INTO END OF WORKPIECE
3. SLIDE TAILSTOCK FORWARD (TO THE LEFT) UNTIL LIVE CENTER POINT IS ABOUT 1" FROM END OF TAP
4. LOCK TAILSTOCK
5. PLACE TAP WRENCH ONTO TAP SHANK AND TIGHTEN
6. TURN TAILSTOCK HANDWHEEL UNTIL LIVE CENTER POINT IS LOCATED IN CENTER DRILLED HOLE ON TAP SHANK. SEE FIGURE 5
7. TURN TAP WRENCH CLOCKWISE WITH ONE HAND
8. TURN TAILSTOCK HANDWHEEL CLOCKWISE WITH OTHER HAND

   CAUTION: PERMIT LIVE CENTER TO APPLY ONLY A SMALL AMOUNT OF PRESSURE ON TAP

fig. 5



TAP HOLE

NOTE: THE PURPOSE OF THE LIVE CENTER IS TO KEEP TAP IN ALIGNMENT WITH WORKPIECE

9. CONTINUE TO TURN TAP WRENCH AND HANDWHEEL UNTIL THREADS ARE 5/16" DEEP

NOTE: CUT THREADS DRY OR WITH KEROSENE LUBRICANT

NOTE: IF TAP BINDS, LOOSEN UP ON LIVE CENTER AND REVERSE TAP DIRECTION TO BREAK CHIPS LOOSE

CAUTION: DO NOT CUT THREADS PAST THREAD RELIEF, AS THIS WILL SCAR TAPER

10. REMOVE TAP AND TAP WRENCH
11. SLIDE TAILSTOCK TOWARD THE RIGHT

12. FINISH TAP COLLET WITH BOTTOMING TAP

1. PLACE BOTTOMING TAP INTO WORKPIECE

   NOTE: BOTTOMING TAP WILL GIVE FULL DEPTH THREAD

2. SCREW TAP INTO WORK BY HAND UNTIL TAP BECOMES TIGHT

   CAUTION: DO NOT CROSS THREAD TAP

3. PLACE TAP WRENCH ONTO TAP SHANK AND TIGHTEN
4. FINISH TAP HOLE AS PER DRAWING
5. REMOVE TAP AND TAP WRENCH
6. INSPECT THREADS
7. REMOVE COLLET FROM MACHINE
8. HOLD FOR ASSEMBLY

SKETCHES: DRAWING #16: SINGLE-POINT SCRIBER

REFERENCES: REF. #3, PP. 135-208
REF. #4, PP. 217-291

JOB SHEET
ON
ENGINE LATHE

JOB:	SINGLE-POINT SCRIBER
MATERIALS:	ONE PIECE 1/8" DIAMETER x 2 1/2" DRILL ROD
TOOLS AND EQUIPMENT:	ENGINE LATHE, COLLET ATTACHMENT, 1/8" COLLET, MILL FILE, 6" RULE, LAYOUT DYE, SCRIBE, 1/16" RADIUS GAGE ALTERNATE: TOOL POST GRINDER
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #3, LATHE, PP. 193-194, 196-198, REF. #4, LATHE, PP. 255-256; CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE NOTE: SCRIBER POINT MAY BE ROUGH GROUND ON PEDESTAL GRINDER BEFORE FILED OR GROUND ON THE LATHE

PROCEDURE AND/OR TASKS:

VII-B-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITIONS
VII-O-3 (TS)	FILE AND POLISH SCRIBER POINT

ALTERNATE TASKS

X-H-3 (TS)	SET UP TOOL POST GRINDER
X-H-3a (TS)	GRIND SCRIBER POINT
	ROUTE TO BENCH FOR HEAT TREATING

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS
5. CHECK WITH INSTRUCTOR ON PROCEDURE TO FOLLOW TO GRIND POINT

TASK SHEET VII-O-3 (TS)

TASK: FILE AND POLISH SCRIBER POINT

JOB: SINGLE-POINT SCRIBER

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 1/8" COLLET, MILL FILE, 6" RULE, LAYOUT DYE, SCRIBE ABRASIVE, 1/16" RADIUS GAGE, 240 GRIT

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK WORKPIECE	1. SET UP COLLET ATTACHMENT WITH 1/8" COLLET. SEE VII-A-1a (TS)
	2. POSITION WORKPIECE IN COLLET NOTE: WORKPIECE EXTENDED OUT FROM COLLET 1/2"
	3. TIGHTEN COLLET
2. FILE 1/16" RADIUS	1. SELECT MILL FILE
	2. FILE RADIUS NOTE: STROKE FILE FORWARD WHILE ROLLING FILE OFF THE END OF WORKPIECE CAUTION: KEEP HANDS AND CLOTHES CLEAR OF MACHINE
	3. INSPECT WITH 1/16" RADIUS GAGE
	4. POLISH RADIUS WITH 240 GRIT ABRASIVE
	5. LOOSEN COLLET
	6. REMOVE WORKPIECE
3. FILE SCRIBER POINT	1. INSERT WORKPIECE INTO COLLET NOTE: PLACE RADIUS END OF WORKPIECE INTO COLLET WITH 1 1/4" PROTRUDING OUT
	2. LAY OUT LENGTH OF SCRIBER POINT TAPER NOTE: HOLD 1 1/8"
	3. FILE TAPER NOTE: START FILE AT POINT HOLDING APPROXIMATE ANGLE OF TAPER NOTE: STROKE FILE FORWARD WITH STEADY FIRM STROKES CAUTION: DO NOT APPLY HEAVY PRESSURE AS THIS WILL BEND WORKPIECE

4. INSPECT TAPER
   1. CHECK FOR FLAT PLACES
      NOTE: CAUSED BY FILING IN ONE PLACE TOO LONG
   2. CHECK FOR STRAIGHT TAPER
   3. CHECK LENGTH

5. POLISH
   1. USE 240 GRIT ABRASIVE
      NOTE: IF WORKPIECE HAS DEEP SCRATCHES, USE COARSE GRIT ABRASIVE FIRST
   2. SET SPINDLE SPEED ABOUT 600 RPM.
   3. PLACE ABRASIVE AROUND WORKPIECE AND APPLY LIGHT PRESSURE
      CAUTION: DO NOT HOLD TIGHTLY PERMITTING FINGERS TO GET CAUGHT BETWEEN ABRASIVE AND WORKPIECE
      NOTE: WHERE EXTREME ACCURACY AND FINISH IS DESIRED, ROUGH OUT TAPER AND USE TOOL POST GRINDER FOR FINISH GRINDING. SEE X-H-3 (TS) AND X-H-3a (TS)
   4. REMOVE WORKPIECE FROM COLLET
   5. ROUTE TO BENCH FOR ASSEMBLY

SKETCHES: DRAWING #16: SINGLE POINT SCRIBER

REFERENCES: REF. #3, PP. 193-194
REF. #4, PP. 255-256

IV-H-1 (J)

JOB SHEET
IN
HEAT TREAT

JOB:	SINGLE-POINT SCRIBER
MATERIALS:	SINGLE-POINT SCRIBER AS MACHINED
TOOLS AND EQUIPMENT:	BUNSEN BURNER OR EQUIVALENT, LIGHTER, TONGS, QUENCHING OIL, 240 GRIT ABRASIVE, 400 GRIT ABRASIVE, WAX, WIPING RAG
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REFERENCE #3, PP. 377-381, 384-385 NOTE: BUNSEN BURNER OR WELDING TORCH MAY BE USED TO HEAT METAL CHECK WITH INSTRUCTOR BEFORE STARTING THE JOB.
PROCEDURE AND/OR TASKS:	IV-H-1 (TS) HEAT TREAT SCRIBER POINT IV-H-1a (TS) FLAME COLOR SCRIBER POINT ROUTE TO BENCH FOR ASSEMBLY
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. CHECK HEATING EQUIPMENT FOR PROPER OPERATION 2. CHECK CORRECT HARDENING OF SCRIBER 3. CHECK CORRECT STRESS RELIEF 4. CHECK FOR CORRECT FLAME COLOR

TASK SHEET

IV-H-1 (TS)

TASK: HEAT TREAT SCRIBER POINT

JOB: SINGLE-POINT SCRIBER

TRADE: MACHINIST

TOOLS AND MATERIALS: BUNSEN BURNER, LIGHTER, TONGS
NOTE: SMALL TIP WELDING TORCH CAN BE USED IN PLACE OF BUNSEN BURNER
QUENCHING OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LIGHT BUNSEN BURNER	1. STRIKE MATCH OR LIGHTER 2. CUT ON GAS NOTE: IF USING PROPANE TORCH OR OXYACTYLENE TORCH USE SMALL TIP WITH SLIGHT CARBURIZING FLAME
2. HARDEN SCRIBER POINT	1. HOLD WORKPIECE WITH TONGS ON RADIUS END 2. POSITION WORKPIECE ABOUT 1/4" TO 1/2" FROM FLAME. SEE FIGURE 1 CAUTION: DO NOT APPLY FLAME TO POINT OR LET WORKPIECE GET TOO CLOSE AS IT WILL BURN THE WORKPIECE 3. MOVE WORKPIECE BACK AND FORTH UNTIL A CHERRY RED COLOR IS REACHED CAUTION: DO NOT HOLD TOO LONG IN ONE PLACE AS WORKPIECE WILL BURN 4. QUENCH WORKPIECE IN OIL NOTE: HOLD WORKPIECE STRAIGHT UP AND DOWN WHEN QUENCHING, SINCE COOLING IT BY QUENCHING FLAT WILL CAUSE DISTORTION. SEE FIGURE 2 CAUTION: DO NOT PERMIT OIL TO REACH FLASH POINT 5. MOVE WORKPIECE IN AND OUT OIL UNTIL WORKPIECE IS COOLED

fig. 1

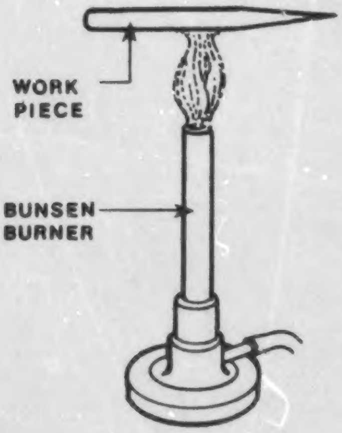
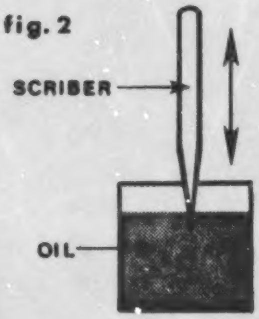


fig. 2



3. STRESS RELIEVE OR TEMPER POINT	1. POLISH WORKPIECE WITH ABRASIVE UNTIL BRIGHT METAL IS REACHED 2. PLACE WORKPIECE OVER FLAME 3. REHEAT UNTIL DARK BLUE COLOR IS REACHED 4. QUENCH AS IN STEP 2, TEST BY SCRIBING A LINE ON A PIECE OF STEEL
4. POLISH WORKPIECE	1. SELECT A PIECE OF 240 GRIT ABRASIVE 2. POLISH UNTIL OXIDE SCALE IS COMPLETELY REMOVED 3. FINISH POLISHING WITH 400 GRIT TO REMOVE FINE SCRATCHES CAUTION: DO NOT OVER POLISH OR POINT WILL BE UNDERSIZE

SKETCHES: DRAWING #16: SINGLE-POINT SCRIBER

REFERENCES: REF. #3, PP. 377-381, 384-385

TASK: FLAME COLOR SCRIBER POINT

JOB: SINGLE-POINT SCRIBER

TRADE: MACHINIST

TOOLS AND EQUIPMENT: BUNSEN BURNER OR EQUIVALENT, LIGHTER, TONGS, QUENCHING OIL, WAX

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LIGHT BURNER	REFER TO: IV-H-1 (TS)
2. POLISH WORKPIECE	1. SELECT PIECE OF 240 GRIT ABRASIVE 2. REMOVE ALL OXIDE SCALE BY POLISHING 3. FINISH POLISHING WITH 400 GRIT ABRASIVE CAUTION: DO NOT OVER POLISH CAUSING SCRIBER POINT TO BE UNDERSIZE
3. HEAT WORKPIECE TO PRESCRIBED COLOR	1. REHEAT AS IN PREVIOUS TASK IV-H-1(TS) 2. MOVE FLAME SLOWLY OVER WORKPIECE UNTIL A DEEP DARK BLUE HAS BEEN REACHED UNIFORMLY CAUTION: DO NOT OVER HEAT WORKPIECE 3. QUENCH IN OIL AS PER IV-H-1 (TS) 4. WIPE WORKPIECE WITH CLEAN RAG TO REMOVE EXCESS OIL 5. WIPE WORKPIECE WITH WAX TO RETAIN FINISH AND PREVENT RUSTING

SKETCHES: DRAWING #16: SINGLE-POINT SCRIBER

REFERENCES: REF. #3, PP. 377-381, 384-385

MACHINE SHOP DOUBLE-POINT SCRIBER-A

ENGINE LATHE 15

BENCH 10

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A DOUBLE-POINT SCRIBER ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAY OUT ACCORDING TO SPECIFICATIONS.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. MAINTAIN SAFE WORKING HABITS.
6. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
7. HOLD ALL SURFACES TO PRESCRIBED FINISH.

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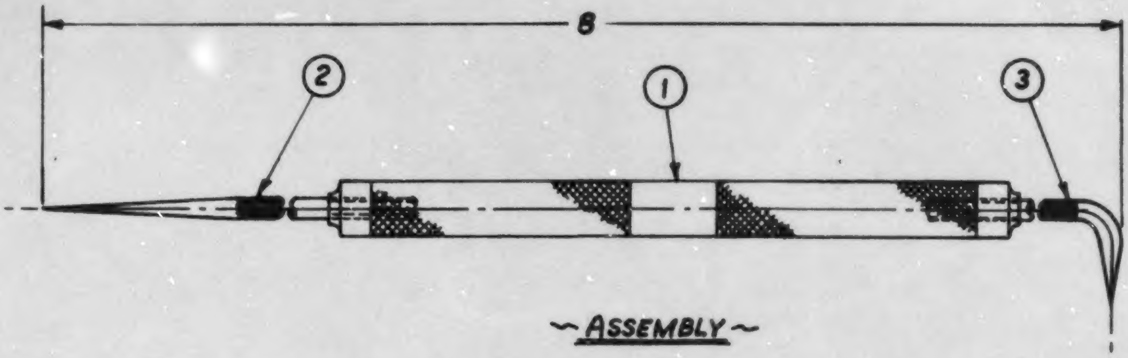
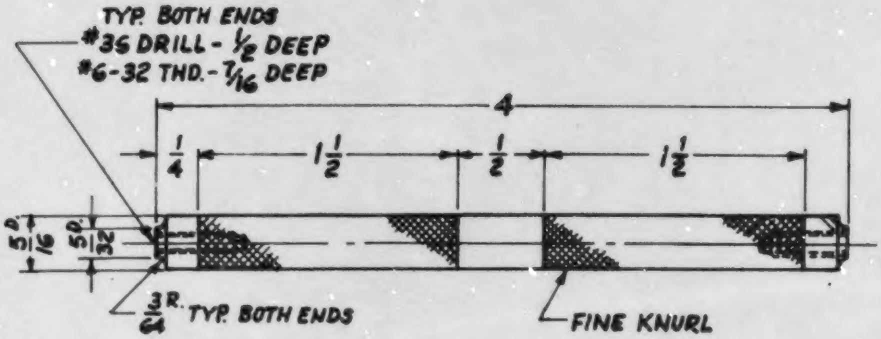
REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS

REF. #4, McCARTHY, WILLARD J., AND SMITH, ROBERT E., MACHINE TOOL TECHNOLOGY

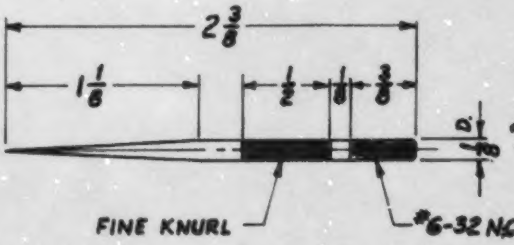
NOTE: IN THIS JOB, THE STUDENT WILL GET ALL NECESSARY MATERIALS FROM SUPPLY PRIOR TO STARTING TASKS FOR CONSTRUCTION OF THIS MULTI-PART JOB. THE STUDENT IS CHARGED WITH KEEPING TRACK OF EACH AND ALL PARTS. THE JOB AND TASK SHEETS ARE WRITTEN FOR COMPLETION OF EACH PART BEFORE PROCEEDING TO THE NEXT PART. IN THIS JOB, TASKS THAT HAVE BEEN REPEATED PREVIOUSLY WILL BE CONSIDERED AS STEPS WITHIN THE TASK OF CONSTRUCTING EACH PART. REFERENCE WILL BE GIVEN TO THOSE PREVIOUS TASKS THAT ARE USED IN THE KEY POINTS. SPECIAL KEY POINTS WILL BE NOTED PERTAINING TO SETUP AND SPECIFICATIONS, WITH TASK SHEETS WRITTEN FOR THOSE TASKS OR SPECIAL TASKS NOT PREVIOUSLY PERFORMED.

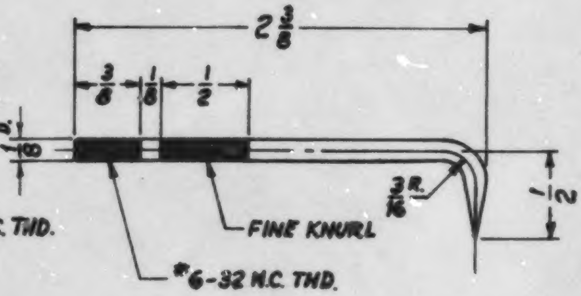


~ASSEMBLY~


TYP. BOTH ENDS
#36 DRILL - 1/2 DEEP
#6-32 THD. - 7/16 DEEP
4
1/4
1 1/2
1/2
1 1/2
5/16 D.
5/32 D.
3/64 R. TYP. BOTH ENDS
FINE KNURL

① MAT'L: ALUMINUM


2 3/8
1 1/8
1/2
1/8
3/8
1/8 D.
FINE KNURL
#6-32 N.C. THD.


2 3/8
3/8
1/8
1/2
1/8 D.
3/16 R.
1/2
FINE KNURL
#6-32 N.C. THD.

② MAT'L: DRILL ROD

③ MAT'L: DRILL ROD

DRAWING NO. 17	DOUBLE-POINT SCRIBER-A	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 15 BENCH JOB NO. 1C	MATERIAL: AS NOTED FINISH: POLISH SCALE: NONE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4 °

JOB SHEET
ON
ENGINE LATHE

JOB:	DOUBLE-POINT SCRIBER-A
MATERIAL:	HANDLE - ONE PIECE 5/16" x 4 1/4" ALUMINUM
TOOLS AND EQUIPMENT:	ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, FACING TOOL, #1 CENTER DRILL, #36 DRILL, #6-32 TAPER TAP, #6-32 BOTTOM TAP, LAYOUT INK, KNURLING TOOL, 6" RULE, LIVE CENTER, SCRIBE, TURNING TOOL, MILL FILE, 0-1" MICROMETER
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #3, LATHE, PP. 135-208; REF. #4, LATHE, PP. 217-285; CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASKS:	VII-B-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	VII-P-1 (TS)	MACHINE HANDLE ON LATHE HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. READ AND UNDERSTAND PROCEDURE TO FOLLOW
2. CHECK MACHINE FOR PROPER OPERATING CONDITIONS
3. CHECK MACHINE FOR PROPER SETUP
4. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-P-1 (TS)

TASK: MACHINE HANDLE ON LATHE

JOB: DOUBLE-POINT SCRIBER-A

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, FACING TOOL, TAILSTOCK DRILL CHUCK, #1 CENTERDRILL, #36 DRILL, #6-32 TAPER TAP, #6-32 BOTTOM TAP, LAYOUT INK, KNURLING TOOL, 6" RULE, LIVE CENTER, SCRIBE, TURNING TOOL, MILL FILE, 0-1" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK MATERIAL	1. SET UP COLLET ATTACHMENT WITH 5/16" COLLET. REFER TO: VII-A-1a (TS) 2. POSITION WORKPIECE IN COLLET NOTE: WORKPIECE EXTENDED OUT FROM COLLET ABOUT 3/4"
2. FACE AND CENTERDRILL	1. REFER TO: VII-C-1 (TS) NOTE: FACE ONLY TO CLEANUP 2. HOLD 1/8"D OR LESS ON BEVELED PART OF CENTERDRILLED HOLE
3. DRILL TAP HOLE	1. REMOVE CENTERDRILL 2. SET UP #36 DRILL IN CHUCK 3. DRILL HOLE. HOLD 1/2" DEPTH. REFER TO: VII-D-1 (TS) 4. REMOVE DRILL AND TAILSTOCK CHUCK 5. REPLACE LIVE CENTER IN TAILSTOCK SPINDLE
4. KNURL HANDLE	1. LOOSEN COLLET 2. EXTEND WORKPIECE FROM COLLET 2" - 2 1/2" AND TIGHTEN COLLET 3. MOVE TAILSTOCK LIVE CENTER INTO POSITION TO SUPPORT WORKPIECE 4. LAY OUT KNURL LENGTH NOTE: SCRIBE LINES 1/4" AND 1 3/4" FROM END OF WORKPIECE AS REFERENCE 5. SET UP KNURLING TOOL 6. KNURL WORKPIECE REFER TO: VII-C-1b (TS)

5. TURN END OF WORKPIECE	1. SET UP TURNING TOOL NOTE: TURNING TOOL TO HAVE 3/64" RADIUS 2. TURN 3/64" RADII. HOLD 5/32" DIAMETER AS SPECIFIED 3. CLEAR LIVE CENTER FROM END OF WORKPIECE
6. TAP END OF WORKPIECE	1. PLACE #6-32 TAPER TAP INTO END OF WORKPIECE 2. PLACE TAP WRENCH ON TAP SHANK AND TIGHTEN 3. SLIDE TAILSTOCK UP TO WORKPIECE NOTE: LEAVE ABOUT 1" CLEARANCE TO TURN LIVE CENTER INTO CENTER-DRILLED HOLE OF TAP 4. MOVE LIVE CENTER AGAINST TAP SHANK CENTER HOLE NOTE: SOME TAPS WILL NOT HAVE THE CENTER DRILLED HOLE; THEREFORE, THIS METHOD COULD NOT BE USED 5. CUT THREADS AS IN VII-O-2 (TS) 6. RECHASE THREADS TO CLEAN UP AND GIVE FULL THREAD DEPTH WITH BOTTOM TAP
7. MACHINE OPPOSITE END	1. REVERSE ENDS NOTE: KNURLED END WILL BE PLACED IN COLLET 2. CHUCK MATERIAL IN COLLET NOTE: LEAVE SUFFICIENT WORKPIECE PROTRUDING OUT TO CLEAR KNURLING TOOL 3. FACE AND CENTERDRILL WORKPIECE AS PER STEP 2. HOLD 4" LENGTH 4. DRILL TAP HOLE AS PER STEP 3 5. LAY OUT AND KNURL WORKPIECE AS PER STEP 4 6. TURN END OF WORKPIECE AS PER STEP 5 NOTE: HOLD 3/64" RADIUS AND 5/32" DIAMETER 7. TAP HOLE WITH #6-32 THREAD 8. BURR EDGES

HOLD FOR ASSEMBLY

SKETCHES: DRAWING #17: DOUBLE-POINT SCRIBER-A

REFERENCES: REF. #3, PP. 135-208

REF. #4, PP. 217-291

JOB SHEET
ON
ENGINE LATHE

JOB: DOUBLE-POINT SCRIBER-A

MATERIAL: STRAIGHT SCRIBER POINT, ONE PIECE 1/8" x 2 3/8" DRILL ROD, CURVED SCRIBER POINT, ONE PIECE 1/8" x 2 7/8" DRILL SPECIAL TOOL "A" FOR WORKPIECE SUPPORT- 1/2" x 1" C.R. ROUND, SPECIAL TOOL "B" FOR FORMING CURVED SCRIBER, C.R. 1/8" PIPE x 6" LONG

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 1/8" COLLET, 1/2" COLLET, MILL FILE, KNURLING TOOL, #6-32 DIE, 240 GRIT EMERY, BENCH VISE, DIE STOCK, BUNSEN BURNER, OIL AND QUENCHING CONTAINER, TONGS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB STUDY PROCEDURES AND TECHNIQUES USED IN JOB #16, VII-O-3 (J) SINGLE-POINT SCRIBER. ALSO, REFER TO REF. #3, LATHE, PP. 193-194, 196-198, REF. #4, LATHE, PP. 255-256. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURE AND/OR TASK:

VII-B-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-P-2 (TS)	TO MAKE SPECIAL HOLDER "A"
VII-P-2a (TS)	MACHINE STRAIGHT SCRIBER POINTS ON LATHE
X-H-3a	GRIND SCRIBER POINT (ALTERNATE TASK) ROUTE TO BENCH

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS
5. CHECK WITH INSTRUCTOR ON PROCEDURE TO FOLLOW TO GRIND POINT

TASK SHEET

VII-P-2 (TS)

TASK:	MAKE SPECIAL TOOL HOLDER "A"
JOB:	DOUBLE-POINT SCRIBER-A
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, COLLET ATTACHMENT, 1/2" COLLET, FACING TOOL, TAILSTOCK DRILL CHUCK, #1 CENTERDRILL, #30 DRILL, MILL FILE, ONE PIECE COLD ROLL 1/2"^{D} x 1"

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK MATERIAL	1. SET UP COLLET ATTACHMENT WITH 1/2" COLLET. REFER TO VII-A-1a (TS) 2. POSITION WORKPIECE IN COLLET NOTE: APPROXIMATELY 1/4" PROTRUDING OUT FROM COLLET
2. FACE AND CENTERDRILL	1. REFER TO VII-C-1 (TS) NOTE: FACE TO CLEAN UP ONLY 2. CENTERDRILL TO ACT AS PILOT FOR #30 DRILL
3. DRILL HOLE	1. REPLACE CENTERDRILL WITH #30 DRILL 2. DRILL HOLE TO SPECIFIED DEPTH AS PER SKETCH, FIGURE 1. REFER TO: VII-D-1 (TS) 3. BURR EDGES 4. REMOVE WORKPIECE 5. REMOVE DRILL 6. REMOVE 1/2" COLLET

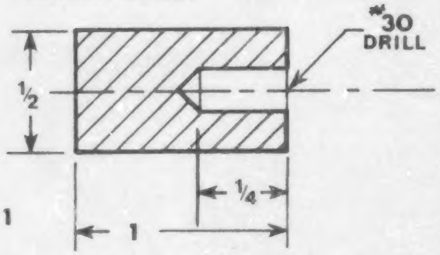


fig. 1

SKETCHES:	DRAWING #17: DOUBLE-POINT SCRIBER-A FIGURE 1, STEP #3 NO REQUIRED REFERENCES

TASK SHEET VII-P-2a (TS)

TASK:	MACHINE SCRIBER POINTS ON LATHE
JOB:	DOUBLE-POINT SCRIBER-A
TRADE:	MACHINIST
TOOLS AND EQUIPMENT:	ENGINE LATHE, COLLET ATTACHMENT, 1/8" COLLET, KNURLING TOOL, MILL FILE, #6-32 DIE AND DIE STOCK, 240 GRIT EMERY, SPECIAL HOLDER "A"

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK MATERIAL NOTE: FIRST SCRIBER POINT	1. SET UP COLLET ATTACHMENT WITH 1/8" COLLET. REFER TO VII-A-1a (TS) 2. POSITION WORKPIECE IN COLLET NOTE: 1 1/4" OF WORKPIECE PROTRUDING OUT 3. CHUCK SPECIAL HOLDER "A" IN TAILSTOCK DRILL CHUCK 4. SLIDE TAILSTOCK UP TO WORKPIECE NOTE: LOCK IN POSITION ABOUT 1/2" FROM WORKPIECE 5. TURN TAILSTOCK HAND WHEEL UNTIL WORKPIECE BOTTOMS INTO HOLDER "A" CAUTION: DO NOT APPLY HARD PRESSURE AGAINST WORKPIECE
2. KNURL WORKPIECE	AS PER PREVIOUS TASK VII-O-1 (TS) STEP 4
3. THREAD END	1. MOVE TAILSTOCK FROM WORKPIECE 2. FASTEN #6-32 DIE INTO DIE STOCK 3. TURN MACHINE SPINDLE ON AND FILE SLIGHT BEVEL ON END OF WORKPIECE NOTE: THIS PROVIDES EASY START OF DIE 4. CENTER DIE ON WORKPIECE NOTE: BEVELED TEETH OF DIE TOWARD WORKPIECE 5. TURN DIE STOCK CLOCKWISE NOTE: APPLY FIRM PRESSURE AGAINST END OF WORKPIECE WITH DIE AND THUMB CAUTION: DO NOT EXERT DOWNWARD PRESSURE OR PRESSURE AGAINST THE

	SIDE OF THE WORKPIECE, AS THIS WILL CAUSE IT TO BEND 6. CONTINUE TO TURN DIE CLOCKWISE UNTIL SPECIFIED LENGTH OF THREAD IS CUT NOTE: BACK DIE OFF ABOUT EVERY TWO TURNS OR WHEN IT BENDS TO BREAK CHIPS LOOSE NOTE: HOLD 3/8" THREAD LENGTH 7. REMOVE WORKPIECE FROM COLLET
5. MACHINE SECOND SCRIBER POINT	FOLLOW SAME PROCEDURE AS WITH FIRST SCRIBER POINT
6. FILE STRAIGHT SCRIBER POINT	1. LOOSEN 1/8" COLLET 2. ADJUST LENGTH OF WORKPIECE TO 1 1/4" PROTRUDING OUT 3. LAY OUT LENGTH OF SCRIBER POINT NOTE: HOLD 1 1/8" IN LENGTH 4. FILE AND POLISH TAPER AS PER VII-O-3 (TS) STEPS 3, 4, AND 5 NOTE: TOOL POST GRINDER MAY BE USED AS AN ALTERNATE, AS IN VII-O-3 (TS) 5. LOOSEN COLLET AND REMOVE WORKPIECE
7. FILE CURVED SCRIBER POINT	1. REVERSE ENDS OF WORKPIECE IN COLLET 2. TIGHTEN WORKPIECE IN COLLET NOTE: HOLD 1 1/4" AS IN STEP 6 3. FOLLOW SAME PROCEDURE AS IN STEP 6 4. REMOVE FROM MACHINE AND INSPECT 5. SECURE MACHINE ROUTE BENCH FOR FORMING CURVED SCRIBER POINT AND HEAT TREAT

SKETCHES: DRAWING #17: DOUBLE-POINT SCRIBER-A

REFERENCES: REF. #3, PP. 193-194
REF. #4, PP. 255-256

JOB SHEET
ON
BENCH

IV-I-1 (J)

JOB: DOUBLE-POINT SCRIBER-A

MATERIAL: SCRIBER POINT AS MACHINED ON THE LATHE

TOOLS AND EQUIPMENT: WORK BENCH, BENCH VISE, SHIM STOCK, BUNSEN BURNER OR EQUIVALENT, QUENCHING OIL AND CAN, TONGS, 240 GRIT EMERY, SPECIAL TOOL "B" (1/8" PIPE - 6" LONG), 3/16" x 2" LONG COLD ROLL ROUND RADIUS PIN

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB STUDY PROCEDURES AND TECHNIQUES USED IN JOB #16, VII-O-3 (J) SINGLE-POINT SCRIBER. ALSO, REFER TO REFERENCE #3, PP. 377-381 AND PP. 384-385. CHECK WITH INSTRUCTOR BEFORE STARTING THE TASK.

PROCEDURES AND/OR TASK:

IV-I-1 (TS)	FORM 3/16" RADIUS ON SCRIBER POINT
IV-H-1 (TS)	HEAT TREAT SCRIBER POINTS
IV-H-1a (TS)	FLAME COLOR SCRIBER POINTS
	ROUTE TO BENCH FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

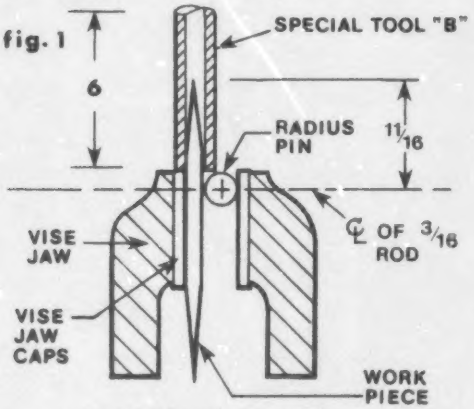
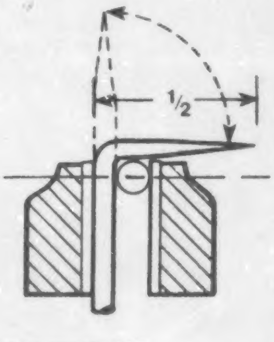
1. CHECK LAY OUT FOR BENDING RADIUS
2. CHECK ON EQUIPMENT FOR HEATING WORKPIECE
3. CHECK OIL TO BE USED FOR QUENCHING

TASK SHEET

IV-I-1 (TS)

TASK:	FORM 3/16" RADIUS ON SCRIBER POINT
JOB:	DOUBLE-POINT SCRIBER-A
TRADE:	MACHINIST
TOOLS AND MATERIALS:	WORK BENCH, BENCH VISE, SHIM STOCK, BUNSEN BURNER OR EQUIVALENT, QUENCHING OIL AND CAN, TONGS, 240 GRIT EMERY, SPECIAL TOOL "B" (1/8" PIPE-6" LONG) 3/16" x 2" LONG C.R. RD. RADIUS PIN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAY OUT BEND LINES	1. INK WORKPIECE 2. LAY OUT START OF 3/16" RADIUS BEND NOTE: HOLD 11/16" FROM END
2. CLAMP WORKPIECE fig. 1  SPECIAL TOOL "B" 6 RADIUS PIN 11/16 VISE JAW ℄ OF 3/16 ROD VISE JAW CAPS WORK PIECE	1. CLAMP WORKPIECE IN VISE AS ILLUSTRATED IN FIGURE #1 NOTE: WORKPIECE SHOULD BE PROTECTED WITH SHIM STOCK UNLESS VISE HAS JAW CAPS 2. CHECK DISTANCE FROM CENTER LINE OF 3/16" ROD TO END OF SCRIBER POINT NOTE: HOLD 11/16" DISTANCE. SEE FIGURE 1 3. CLAMP WORKPIECE FIRMLY NOTE: TOP OF 3/16" ROD SHOULD BE EVEN WITH TOP OF VISE JAW
3. FORM 3/16" RADIUS fig. 2  	1. LIGHT BUNSEN BURNER OR TORCH AS PER IV-H-1 (TS) STEPS 1 AND 2 2. HEAT ENTIRE WORKPIECE ABOVE JAWS TO CHERRY RED CAUTION: DO NOT OVERHEAT AND BURN WORKPIECE 3. PLACE SPECIAL TOOL "B" OVER WORKPIECE AS IN FIGURE 2 NOTE: 1/8" PIPE - 6" LONG 4. BEND TO 90° ANGLE 5. REMOVE FROM VISE AND QUENCH IN OIL
4. HEAT TREAT SCRIBER POINTS	AS PER IV-H-1 (TS) STEPS 1 THROUGH 4

5. FLAME COLOR SCRIBER POINTS	AS PER IV-H-1 (TS) STEP 5 ASSEMBLE ALL PARTS FOR FINAL INSPECTION

SKETCHES: DRAWING #17: DOUBLE-POINT SCRIBER-A

REFERENCES: REF. #3, PP. 377-381, 384-385

MACHINE SHOP DOUBLE-POINT SCRIBER B

ENGINE LATHE 16

HORIZONTAL MILLING MACHINE 13

BENCH 11

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWING, OPERATE DESIGNATED MACHINES, AND CONSTRUCT A DOUBLE-POINT SCRIBER ACCORDING TO SPECIFICATIONS USING VARIOUS MACHINE TOOLS AND EQUIPMENT CALLED FOR IN THE JOB

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES
2. SET UP AND PREPARE MACHINE FOR JOB
3. LAYOUT ACCORDING TO SPECIFICATIONS
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS
5. MAINTAIN SAFE WORKING HABITS
6. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES
7. HOLD ALL SURFACES TO PRESCRIBED FINISH

REFERENCES

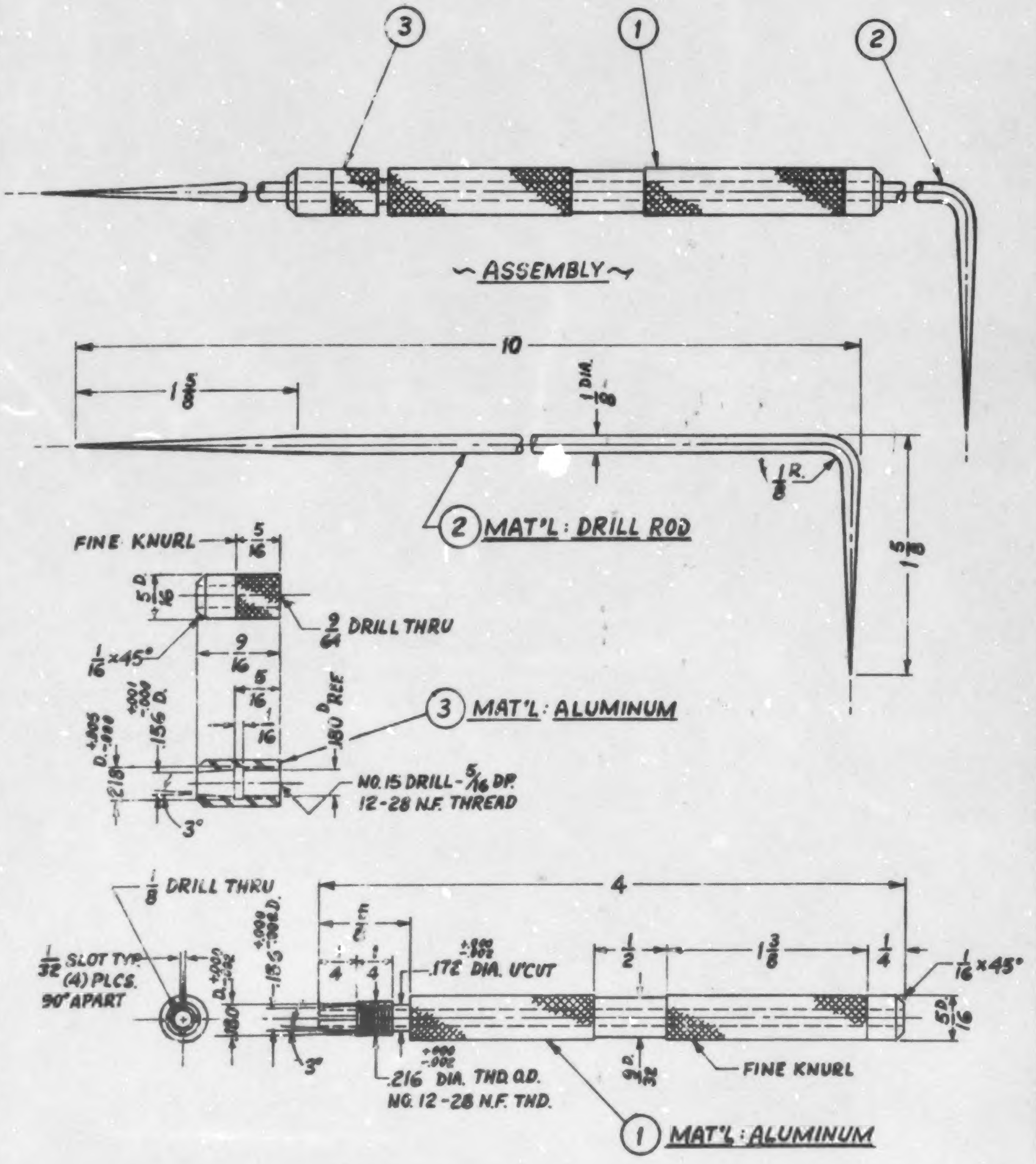
REF. #1, WALKER, JOHN R., MODERN METALWORKING

REF. #2, LUDWIG, OSWALD A., AND MCCARTHY, WILLARD J., METALWORK TECHNOLOGY AND PRACTICE

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS

REF. #4, MCCARTHY, WILLARD J., AND SMITH, ROBERT E., MACHINE TOOL TECHNOLOGY

NOTE: IN THIS JOB THE STUDENT WILL GET ALL NECESSARY MATERIALS FROM SUPPLY PRIOR TO STARTING TASKS FOR CONSTRUCTION OF THIS MULTI-PART JOB. THE STUDENT IS CHARGED WITH KEEPING TRACK OF EACH AND ALL PARTS. THE JOB AND TASK SHEETS ARE WRITTEN FOR COMPLETION OF EACH PART BEFORE PROCEEDING TO THE NEXT PART. IN THIS JOB, TASKS THAT HAVE BEEN REPEATED PREVIOUSLY WILL BE CONSIDERED AS STEPS WITHIN THE TASK OF CONSTRUCTING EACH PART. REFERENCE WILL BE GIVEN TO PREVIOUS TASKS THAT ARE USED IN THE KEY POINTS. SPECIAL KEY POINTS WILL BE NOTED PERTAINING TO SETUP AND SPECIFICATIONS, WITH TASK SHEETS WRITTEN FOR THOSE TASKS OR SPECIAL TASKS NOT PREVIOUSLY PERFORMED.


3
1
2
~ASSEMBLY~
10
1 5/8
1/100 DIA.
1/8 R.
1 5/8
2 MAT'L: DRILL ROD
FINE KNURL
5/16
5/16 D.
9/64 DRILL THRU
1/16 × 45°
9/16
5/16
1/16
.180 D REF
+.001 -.000 .156 D.
D. +.005 -.000 .218
3°
3 MAT'L: ALUMINUM
NO. 15 DRILL - 5/16 DP.
12-28 N.F. THREAD
1/8 DRILL THRU
1/32 SLOT TYP. (4) PLCS. 90° APART
D. +.000 -.002 .180
+.000 -.002 .156 D.
3/8
1/4
1/4
+.000 -.002 .172 DIA. U'CUT
4
1/2
1 3/8
1/4
1/16 × 45°
5/16 D.
3°
+.000 -.002 .216 DIA. THD. O.D.
NO. 12-28 N.F. THD.
9/32 D.
FINE KNURL
1 MAT'L: ALUMINUM

DRAWING NO. 18	DOUBLE-POINT SCRIBER "B"	TOLERANCES UNLESS OTHERWISE NOTED
BENCH JOB NO. 11 LATHE JOB NO. 16 MILLING JOB NO. 13	MATERIAL: NOTED FINISH: POLISH SCALE: NONE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-Q-1(J)

JOB SHEET
ON
ENGINE LATHE

JOB: DOUBLE-POINT SCRIBER B

MATERIALS: HANDLE-ONE PIECE 5/16" X 4 1/4" ROUND ALUMINUM

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, LEFT AND RIGHT HAND FACING TOOL, LEFT AND RIGHT HAND TURNING TOOL, #1 CENTER DRILL, TAILSTOCK DRILL CHUCK, LIVE CENTER, KNURLING TOOL, 1/8" DRILL, 1/8" CUT-OFF TOOL, 60° THREADING TOOL, 6" RULE, CENTER GAGE, 0-1" RULE, HORIZONTAL MILLING MACHINE, ARBOR AND SPACING COLLARS, 1/32" SLITTING SAW, DIVIDING HEAD, UNIVERSAL CHUCK

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #3 LATHE, PP. 135-208; MILLING MACHINE, PP. 229-285; REF. #4 LATHE, PP. 217-285; MILLING MACHINE, PP. 317-403. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITIONS
VII-Q-1(TS)	MACHINE HANDLE ON LATHE ROUTE TO MILLING MACHINE
IX-A-1(TS)	CHECK MACHINE FOR OPERATING PROPER CONDITIONS
IX-L-1(TS)	MILL 1/32" SLOTS IN HANDLE HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITIONS
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET VII-Q-1(TS)

TASK:	MACHINE HANDLE ON LATHE
JOB:	DOUBLE-POINT SCRIBER B
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, COLLET ATTACHMENT, 5/16" COLLET, LEFT AND RIGHT FACING TOOL, LEFT AND RIGHT HAND TURNING TOOL, #1 CENTERDRILL, TAILSTOCK DRILL CHUCK, LIVE CENTER, KNURLING TOOL, 1/8" DRILL, 1/8" CUT-OFF TOOL, 60° THREADING TOOL, 6" RULE, CENTER GAGE, 0-1" RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK MATERIAL	1. SET UP COLLET ATTACHMENT WITH 5/16" COLLET. REFER TO: VII-A-1a(TS)
	2. POSITION WORKPIECE IN COLLET NOTE: STOCK EXTENDED OUT TO CLEAR FOR CLEANUP FACING AND CENTER DRILLING
2. FACE AND CENTERDRILL	1. REFER TO: VII-C-1(TS) NOTE: FACE TO CLEAN UP
	2. CENTERDRILL FIRST END
	3. REVERSE ENDS
	4. FACE AND CENTER DRILL SECOND END NOTE: HOLD 4" LENGTH
3. KNURL WORKPIECE	1. REMOVE DRILL CHUCK FROM TAILSTOCK
	2. REPLACE LIVE CENTER
	3. REPOSITION WORKPIECE NOTE: SLIDE WORKPIECE SUFFICIENTLY TO CLEAR KNURLING TOOL
	4. LAY OUT LENGTH OF KNURLS AS SPECIFIED ON DRAWING NOTE: LAY OUT THE TWO EXTREME ENDS OF THE KNURL. THE MIDDLE PART WILL BE TURNED
	5. KNURL WORKPIECE AS PER VII-C-1a(TS)
4. TURN 9/32"^{D} RELIEF	1. LAY OUT RELIEF WORKPIECE NOTE: HOLD 1 5/8" FROM END AND 2 1/8" FROM SAME END

	2. STEP UP RIGHT HAND TURNING TOOL NOTE: NOSE RADIUS 1/64" 3. TURN $9/32''^{D}$ RELIEF NOTE: HOLD 1/2" WIDTH 4. SET UP LEFT HAND TURNING TOOL 5. FINISH TURN RELIEF BLENDING THE TWO CUTS TOGETHER. HOLD 1/2" WIDTH NOTE: THIS WILL GIVE TWO SQUARE SHOULDERS
5. TURN 1/16" X 45° BEVEL	REFER TO: VII-F-1a(TS)
6. DRILL 1/8" HOLE	1. LOOSEN COLLET 2. POSITION WORKPIECE WITH 1" PROTRUDING OUT 3. SET UP DRILL IN TAILSTOCK DRILL CHUCK 4. DRILL 1/8" HOLE 2 1/2" DEEP NOTE: A LONG SHANK DRILL WILL BE REQUIRED CAUTION: FEED DRILL WITH CAUTION TO AVOID BREAKING OR DRILLING OFF CENTER NOTE: BACK DRILL OUT FREQUENTLY TO CLEAR CHIPS 5. REMOVE WORKPIECE AND REVERSE ENDS 6. CHUCK WORKPIECE AS BEFORE NOTE: 1" PROTRUDING FROM COLLET
7. TURN COLLET END	1. SET UP TURNING TOOL 2. TURN DIAMETER. HOLD $.216''\,{}^{+.000}_{-.002}$ DIAMETER, 5/8" FROM END. REFER TO: VII-I-1(TS) 3. REMOVE TURNING TOOL
8. TURN #12-28 THREAD	1. TURN 1/8" THREAD RELIEF AS SPECIFIED. HOLD .172" DIAMETER 2. SET GEAR BOX FOR 28 THREADS PER INCH 3. SET SPINDLE SPEED TO 1/4 TURNING SPEED 4. TURN SPECIFIED THREADS AS PER VII-I-1(TS) 5. CLEAN AND INSPECT THREADS 6. REMOVE THREADING TOOL

9. TURN 6° TAPER ON COLLET	1. SET UP TURNING 2. SET TAPER ATTACHMENT FOR REQUIRED TAPER 3. TURN TAPER AS PREVIOUS TASK VII-B-1h(TS) NOTE: HOLD .216" DIAMETER AT LARGE END X 5/16" SPECIFIED LENGTH NOTE: A 1/32" FLAT RELIEF MAY BE NECESSARY AT THE LARGE END OF TAPER FILE RELIEF
10. FINISH DRILL 1/8" HOLE	1. RESET DRILL IN DRILL CHUCK 2. FINISH DRILL 1/8" HOLE AS IN STEP 6 3. REMOVE FROM COLLET ROUTE TO MILLING MACHINE

SKETCHES: DRAWING #18: DOUBLE-POINT SCRIBER B

REFERENCES: REF. #3, PP. 135-208
REF. #4, PP. 217-291

VII-Q-2(J)

JOB SHEET
ON
ENGINE LATHE

JOB: DOUBLE-POINT SCRIBER B

MATERIALS: ONE PIECE 5/16" DIAMETER X 1 1/2" ALUMINUM ROUND
NOTE: THIS PROVIDES MATERIAL FOR CHUCKING

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 5/16 COLLET, FACING TOOL, TURNING TOOL, 5/32 DRILL, TAILSTOCK DRILL CHUCK, #14 DRILL, #2 CENTER DRILL, SPECIAL INTERNAL GROOVING TOOL, SPECIAL 6° TAPERED REAMER, 0-1 MICROMETER, #12-28 TAPER TAP, #12-28 BOTTOM TAP, TAP WRENCH, INSIDE CALIPERS, MILL FILE, 6" RULE, 1/8" CUT-OFF TOOL

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #3, LATHE, PP. 135-208; REF. #4, LATHE, PP. 217-285. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES OR STARTING SPECIAL MACHINING OPERATIONS

PROCEDURE AND/OR TASKS:

VII-B-1(TS) CHECK MACHINE FOR PROPER OPERATING CONDITIONS

VII-O-2(TS) MACHINE COLLET NUT ON LATHE HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASKS

1. CHECK MACHINE FOR PROPER OPERATING CONDITIONS
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT AND STANDARDS
5. CHECK WITH INSTRUCTOR ON PROCEDURE IN USE OF SPECIAL TOOLING

VII-Q-3(J)

JOB SHEET
ON
ENGINE LATHE

JOB: DOUBLE-POINT SCRIBER B

MATERIALS: ONE PIECE 1/8" DEAMETER X 11 5/8" DRILL ROD

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 1/8" COLLET, MILL FILE, 6" RULE, LAYOUT DYE, SCRIBE
ALTERNATE: TOOL POST GRINDER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #3, LATHE, PP. 193-194, 196-198; REF. #4, LATHE, PP. 255-256. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE
NOTE: SCRIBER POINT MAY BE ROUGH GROUND ON PEDESTAL GRINDER BEFORE FILED OR TOOL POST GROUND ON LATHE

PROCEDURE AND/OR TASKS:

VII-B-1(TS)	CHECK MACHINE FOR PROPER OPERATING CONDITIONS
VII-O-3(TS)	FILE AND POLISH SCRIBER POINTS

ALTERNATE TASKS

X-H-3(TS)	SET UP TOOL POST GRINDER
X-H-3a(TS)	GRIND TAPER ON WORKPIECE
	ROUTE TO BENCH
IV-I-1(TS)	FORM 3/16" RADIUS ON SCRIBER POINT
IV-H-1(TS)	HEAT TREAT SCRIBER POINTS
IV-H-1a(TS)	FLAME COLOR SCRIBER POINTS
	ASSEMBLE PARTS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS
5. CHECK WITH INSTRUCTOR ON PROCEDURE TO FOLLOW TO GRIND SCRIBER POINT

MACHINE SHOP: V-BLOCKS

MILLING MACHINE	14
HORIZONTAL SAW	3
HEAT TREAT	6
SURFACE GRINDER	2

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWING, OPERATE DESIGNATED MACHINES, AND CONSTRUCT TWO V-BLOCKS ACCORDING TO SPECIFICATIONS.

CHECKING STANDARDS

1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
2. HOLD ALL SURFACES TO PRECISION FINISH.
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT.
5. MAINTAIN SAFETY ATTITUDE.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

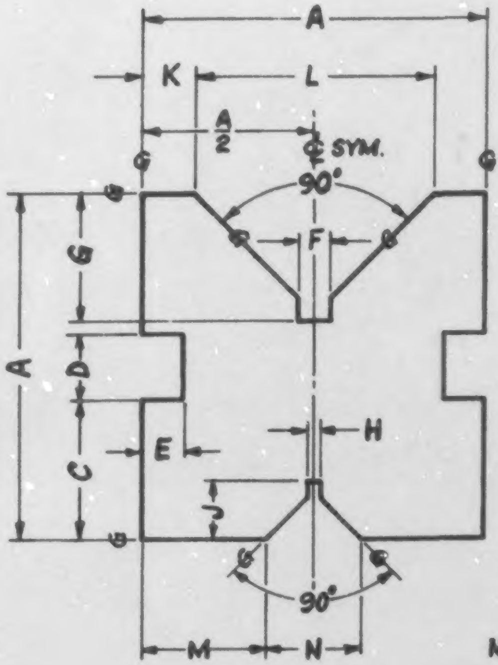
REF. #2, LUDWIG, OSWALD A., AND McCARTHY, WILLARD J., METALWORK TECHNOLOGY AND PRACTICE.

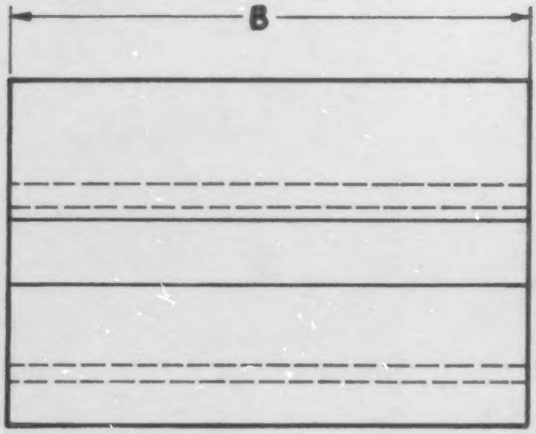
REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

REF. #4, McCARTHY, WILLARD J., AND SMITH, ROBERT E., MACHINE TOOL TECHNOLOGY.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED TO CONSTRUCT TWO V-BLOCKS, 3" x 3" x 4". THE DIMENSIONS ARE UNDER COLUMN III ON DRAWING. SHOULD ANY OTHER SIZES BE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.

IN THIS JOB, ALL TASKS THAT HAVE BEEN PREVIOUSLY PERFORMED WILL BE WRITTEN AS STEPS IN CONSTRUCTING THE V-BLOCKS. THOSE TASKS THAT HAVE NOT BEEN PERFORMED PREVIOUSLY WILL BE WRITTEN AS SUCH. REFERENCES WILL BE MADE TO PREVIOUS TASK SHOULD THE STUDENT REQUIRE SUCH ASSISTANCE.





NOTE: H.T. 38-42 BEFORE GRINDING

SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N
1½	1½	2	5/8	1/4	3/16	1/8	9/16	1/16	1/4	1/4	1	9/16	3/8
2	2	3	13/16	3/8	1/4	3/16	3/4	1/16	11/32	5/16	1⅜	23/32	9/16
3	3	4	1¼	1/2	3/8	1/4	1⅛	1/8	7/16	1/2	2	1⅛	3/4

DRAWING NO. 19

V-BLOCKS

TOLERANCES UNLESS OTHERWISE NOTED

MILLING JOB NO. 14
HEAT TREAT JOB NO. 6
SURFACE GRINDER JOB NO. 2

MATERIAL: 4140 H.R.S.
FINISH: F.A.D.
SCALE: NONE

FRACTIONS - ± 1/64"
DECIMAL - ± .005"
ANGLES - ± 1/4°

IX-M-1 (J)

JOB SHEET
ON
MILLING MACHINE

JOB:	V-BLOCKS
MATERIALS:	ONE PIECE 4130 STEEL, 3 7/16" x 3 7/16" x 8 1/2". BOTH V-BLOCKS WILL BE MACHINED AS ONE, THEN CUT INTO TWO INDIVIDUAL V-BLOCKS
TOOLS AND EQUIPMENT:	MILLING MACHINE (EITHER HORIZONTAL OR COMBINATION HORIZONTAL-VERTICAL) UNIVERSAL VISE, DIAL INDICATOR, ARBOR WITH SPACING COLLARS, 4" PLAIN MILLING CUTTER, 2" SHELL MILL AND ADAPTOR, 6" RULE, 0-1" MICROMETER, 1"-2" MICROMETER, 2"-3" MICROMETER, 3"-4" MICROMETER, MILL FILE, 1/4" PLAIN SIDE MILLING CUTTER, 1/8" SLITTING SAW, 1/2" STAGGERED TOOTH SIDE CUTTING MILL, DEPTH MICROMETER NOTE: IF VERTICAL MILL IS USED, THE 1/4", 1/8", AND 1/2" CUTTERS MAY BE SUBSTITUTED BY END MILLS
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #3, MILLING MACHINE, PP. 229-287; REF. #4, MILLING MACHINE, PP. 317-403. CHECK WITH INSTRUCTOR BEFORE STARTING

PROCEDURES OR TASKS:	IX-A-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITIONS
	IX-H-1 (TS)	SET UP AND MACHINE WORKPIECE SQUARE AND PARALLEL NOTE: HOLD DIMENSION "A" TO 3.000" $^{+.010}_{+.005}$ AND HOLD ENDS TO CLEAN UP FINISH ROUTE TO BENCH FOR LAYOUT
	IX-M-1 (TS)	MACHINE GROOVES AND RELIEFS ROUTE TO HORIZONTAL SAW
	V-A-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITIONS
	V-B-1 (TS)	SAW V-BLOCK INTO TWO EQUAL PARTS ROUTE TO MILLING MACHINE
	IX-H-1 (TS)	MACHINE ENDS TO LENGTH NOTE: HOLD 4.000" + .020 FOR GRINDING ROUTE TO HEAT TREAT
	XI-A-1 (TS)	CHECK FURNACE FOR PROPER OPERATING CONDITION
	XI-A-1d (TS)	HEAT TREAT V-BLOCKS TO SPECIFIED HARDNESS ROUTE TO SURFACE GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE, AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

IX-M-1 (TS)

TASK:	MACHINE GROOVES AND RELIEFS
JOB:	V-BLOCKS
TOOLS AND EQUIPMENT:	MILLING MACHINE, UNIVERSAL VISE, DIAL INDICATOR, ARBOR AND SPACING COLLARS, 1/4" PLAIN SIDE MILLING CUTTER, 1/8" SLITTING SAW, 1/2" STAGGERED TOOTH SIDE MILLING CUTTER, 6" RULE, DEPTH MICROMETER, MILL FILE, 2" SHELL MILL AND ADAPTOR NOTE: 2" END MILL MAY BE USED PARALLEL BARS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP UNIVERSAL VISE	1. VISE IS POSITIONED SO JAWS ARE PARALLEL TO TABLE
	2. POSITION HANDLE AWAY FROM COLUMN NOTE: POSITIONED TOWARD OPERATOR
	3. TRUE VISE WITH DIAL INDICATOR NOTE: VISE WILL BE SET AT 0°
	4. SET VISE VERTICAL PLANE POSITION AT 0° NOTE: VISE WILL BE SET AT 45° LATER WHEN MILLING V-GROOVES
2. MACHINE RELIEF GROOVES AND RECTANGULAR GROOVES	1. REFER TO CHART ON SPEEDS AND FEEDS FOR MACHINING TOOL AND ALLOY STEELS FOR EACH CUTTER SIZE. REF. #1, P. 38-16 AND REF. #2, PP. 549-550
	2. MACHINE ALL RELIEF GROOVES FIRST AND THEN MACHINE RECTANGULAR GROOVES
	3. TRUE WORKPIECE WITH DIAL INDICATOR IN MAKING EACH WORKPIECE SETUP
	4. BURR MACHINED EDGE PRIOR TO RESETTING UP WORKPIECE
	5. USE PARALLEL BARS TO CLEAR TOP OF VISE
A. MILL 1/8" RELIEF GROOVE	1. SET UP AND TRUE WORKPIECE WITH DIAL INDICATOR AS PER IX-E-1 (TS) NOTE: LENGTH OF WORKPIECE WILL BE PARALLEL TO VISE JAWS NOTE: USE PARALLEL BARS TO CLEAR TOP OF VISE WITH SAW

2. SET UP 1/8" SLITTING SAW ON ARBOR
3. CENTER SLITTING SAW ON WORKPIECE AS PER IX-I-1c (TS)
   NOTE: HOLD CENTER LINE REFERENCE DIMENSION A/2 AS PER DRAWING (1 1/2")
4. MILL 1/8" RELIEF SLOT 7/16" DEEP AS PER DRAWING. REFER TO IX-E-1a (TS)
   NOTE: RELIEF SLOT WILL SERVE TO GIVE RELIEF TO MILLING CUTTER AND GRINDING WHEEL WHEN MACHINING V-GROOVE
5. REMOVE WORKPIECE AND BURR EDGES
6. INSPECT DIMENSIONS AS PER DRAWING
7. REMOVE 1/8" SLITTING SAW

B. MACHINE 1/4" RELIEF GROOVE

1. POSITION WORKPIECE WITH PREVIOUS MILLED 1/8" GROOVE DOWNWARD
   NOTE: 1/4" GROOVE WILL BE MACHINED OPPOSITE SIDE OF 1/8" GROOVE AS PER DRAWING
2. SET UP AND TRUE WORKPIECE WITH DIAL INDICATOR. AS PER IX-E-1 (TS)
3. SET UP 1/4" SIDE MILLING CUTTER ON ARBOR
4. CENTER SIDE MILLING CUTTER ON WORKPIECE AS PER IX-I-1c (TS)
   NOTE: HOLD CENTER LINE OF WORKPIECE AS PER DRAWING. REFERENCE DIMENSION A/2
5. REFER TO FEED AND SPEED CHART FOR NECESSARY CORRECTIONS FOR CUTTER
6. MILL 1/4" GROOVE
   NOTE: HOLD 1 1/8" DEPTH AS PER REFERENCE DIMENSION "G"
7. REMOVE WORKPIECE AND BURR EDGES
8. REMOVE 1/4" SIDE MILLING CUTTER
9. INSPECT WORKPIECE AS PER DRAWING
10. WIPE VISE CLEAN

C. MACHINE 1/2" x 3/8" GROOVE

1. TURN WORKPIECE 90°
   NOTE: PREVIOUS MACHINED GROOVES WILL BE AGAINST FACE OF VISE JAWS
2. SET UP AND INDICATE WORKPIECE AS IN PREVIOUS STEPS "A" AND "B"
3. SET UP 1/2" STAGGERED TOOTH SIDE MILLING CUTTER

4. CENTER MILLING CUTTER AS PER IX-E-1a (TS)
   NOTE: HOLD REFERENCE DIMENSION "C"
5. MILL GROOVE TO SPECIFIED DEPTH AS PER IX-E-1a (TS)
   NOTE: HOLD SPECIFIED DIMENSIONS AS PER REFERENCE DIMENSIONS "C", "D", AND "E"
6. REMOVE WORKPIECE AND BURR EDGES
7. INSPECT WORKPIECE
8. WIPE VISE CLEAN

D. MACHINE SECOND 1/2" x 3/8" GROOVE

1. TURN WORKPIECE 180°
   NOTE: PREVIOUS MACHINED 1/2" x 3/8" GROOVE WILL BE POSITIONED ON BOTTOM SIDE
2. SET UP AND MACHINE GROOVE AS IN PREVIOUS STEP "C"
3. REMOVE AND BURR WORKPIECE
   NOTE: HOLD SPECIFIED DIMENSIONS AS PER DRAWING
4. REMOVE MILLING CUTTER AND ARBOR
5. WIPE VISE CLEAN

3. MACHINE V-GROOVES

1. REFER TO CHART SPEEDS AND FEEDS FOR MACHINING TOOL AND ALLOY STEELS. REF. #1, P. 38-16 AND REF. #2, PP. 549-550
2. KEEP CUTTERS FLUSHED WITH COOLANT
3. LAY OUT REFERENCE LINE FOR SMALL GROOVE PARALLEL TO EDGE 1 1/8" (M-DIMENSION) FROM EDGE
4. LAY OUT REFERENCE LINE FOR LARGE GROOVE PARALLEL TO EDGE 1 1/2" (K-DIMENSION) FROM EDGE
   NOTE: REFERENCE LINES WILL BE USED FOR LOCATING CUTTER WHEN MILLING V-GROOVE
5. HOLD .010" FOR SURFACE GRINDING AFTER HEAT TREAT
6. DEPTH OF EACH CUT WILL VARY WITH MACHINE, ALTHOUGH .100" PER CUT IS RECOMMENDED

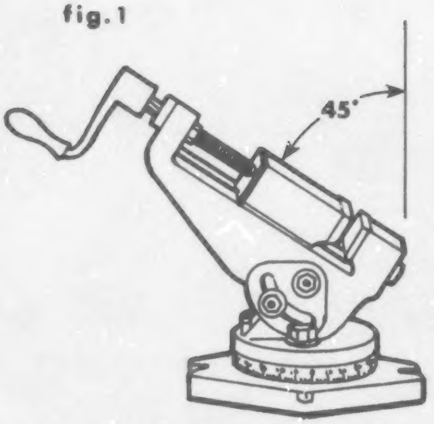
A. MACHINE SMALL V-GROOVE

1. SET UP WORKPIECE IN VISE
   NOTE: SIDE WITH 1/8" SLOT WILL BE

FACING UPWARD

2. TRUE WORKPIECE WITH DIAL INDICATOR AS IN PREVIOUS STEPS
3. SET VISE AT 45° ANGLE. SEE FIGURE 1
   NOTE: DIRECT VISE HANDLE AWAY FROM MILL COLUMN
4. SET UP 2" SHELL MILL AND ADAPTOR
   NOTE: 2" END MILL MAY BE USED
5. POSITION CUTTER DIRECTLY OVER WORKPIECE
6. RAISE TABLE UNTIL CUTTER SCORES WORKPIECE
   NOTE: END OF CUTTER WILL MAKE CONTACT
   NOTE: HOLD LAYOUT REFERENCE LINE SEE FIGURE 2
7. LOCK TRANSVERSAL CROSS FEED
8. CLEAR CUTTER FOR DEPTH OF CUT
9. RAISE TABLE .100"
   NOTE: TOTAL DEPTH WILL BE .530"
10. REPEAT STEPS UNTIL DEPTH IS REACHED
    NOTE: HOLD .010" FOR GRINDING
11. INSPECT WORKPIECE AS PER DIMENSIONS
12. REMOVE AND BURR WORKPIECE
13. CLEAN VISE

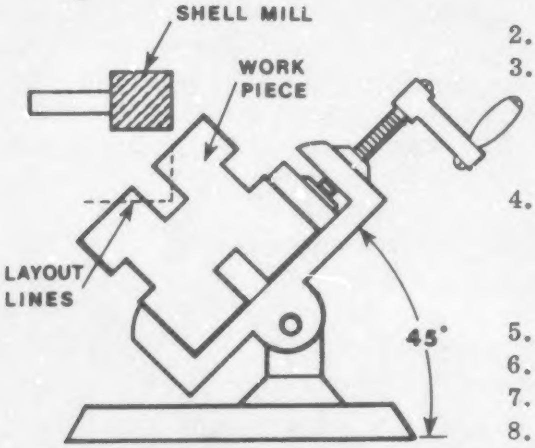
fig.1



B. MACHINE LARGE V-GROOVE

1. SET UP WORKPIECE IN VISE AS IN PREVIOUS STEP 3-A
   NOTE: SMALL V-GROOVE WILL BE POSITIONED DOWNWARD
2. TRUE WORKPIECE WITH DIAL INDICATOR
3. POSITION CUTTER SLIGHTLY ABOVE LAYOUT REFERENCE LINE AS PER STEP 3-A
   NOTE: REFER TO FIGURE 2
4. MACHINE V-GROOVE TO DEPTH
   NOTE: FULL DEPTH IS 1.414". HOLD .010" OVERSIZE FOR SURFACE GRINDING
5. INSPECT WORKPIECE AS PER DRAWING
6. REMOVE WORKPIECE AND BURR
7. CLEAN VISE
8. ROUTE TO SAW

fig.2



4. SAW WORKPIECE INTO TWO EQUAL PARTS	1. CHECK OPERATING CONDITION OF SAW REFER TO V-A-1 (TS) 2. CHECK VISE FOR SQUARE 3. CLAMP WORKPIECE 4. CUT WORKPIECE IN HALF NOTE: LENGTH OF EITHER PART SHOULD NOT BE LESS THAN 4 1/8" 5. REMOVE WORKPIECE AND BURR EDGES 6. ROUTE TO MILLING MACHINE
5. MILL SAWED ENDS OF V-BLOCKS	1. SET UNIVERSAL VISE VERTICAL PLANE POSITION AT 0° AS PER STEP 1 2. SET UP BOTH V-BLOCKS IN VISE TOGETHER NOTE: SAWED END UP 3. TRUE UP WORKPIECES WITH DIAL INDICATOR NOTE: CHECK VERTICALLY FOR WORK BEING TRUE 4. SET UP ARBOR AND 4" PLAIN MILLING CUTTER. REFER TO: IX-A-1b (TS) 5. MILL WORKPIECES TO LENGTH NOTE: HOLD TO 4.020" LENGTH TO ALLOW FOR GRINDING 6. REMOVE WORKPIECES AND BURR EDGES 7. INSPECT WORKPIECES ROUTE TO HEAT TREAT

SKETCHES: DRAWING #19: V-BLOCKS

REFERENCES:
REF. #3, PP. 229-287
REF. #4, PP. 317-403
REF. #3, PP. 57-65

X-J-1 (J)

JOB SHEET
ON
SURFACE GRINDER

JOB: V-BLOCKS

MATERIALS: TWO V-BLOCKS, MILLED TO SHAPE AND HEAT TREATED TO SPECIFICATIONS

TOOLS AND EQUIPMENT: SURFACE GRINDER, MAGNETIC CHUCK, UNIVERSAL VISE, CORRECT GRINDING WHEEL, DIAMOND POINT WHEEL DRESSER AND HOLDER, DIAL INDICATOR, DEPTH MICROMETER, 3"-4" MICROMETER, HONE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 33-8 TO 33-13; REF. #2, PP. 569-582; REF. #3, PP. 287-310. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:

X-H-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
X-H-1a (TS)	INSPECT AND MOUNT CORRECT GRINDING WHEEL
X-H-1b (TS)	TRUE AND DRESS GRINDING WHEEL
X-J-1 (TS)	FINISH GRIND V-BLOCKS

CHECK POINTS: STUDENTS TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT AND STANDARDS

TASK SHEET X-J-1 (TS)

TASK: FINISH GRIND V-BLOCKS

JOB: V-BLOCKS

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, CORRECT GRINDING WHEEL, HONE, UNIVERSAL VISE, MAGNETIC CHUCK, DIAL INDICATOR, 3"-4" MICROMETER, DEPTH MICROMETER, SURFACE GAGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GRIND FIRST SIDE	1. SET UP BOTH V-BLOCKS WITH 1/2" x 3/8" GROOVE FACED UP NOTE: BE SURE MAGNETIC CHUCK SURFACE IS WIPED CLEAN 2. GRIND TO MINIMUM CLEAN UP. REFER TO: X-H-1c (TS) NOTE: APPROXIMATELY .005" 3. REMOVE V-BLOCKS FROM MAGNETIC CHUCK 4. BURR ALL EDGES WITH HONE 5. MEASURE WITH 3"-4" MICROMETER NOTE: THIS MEASUREMENT WILL CONTROL AMOUNT REMOVED ON OPPOSITE SIDE 6. WIPE MAGNETIC CHUCK CLEAN
2. GRIND SECOND SIDE	1. SET UP BOTH V-BLOCKS WITH OPPOSITE SIDE UP NOTE: FIRST SIDE WILL BE FACED DOWN 2. POSITION V-BLOCKS SIDE BY SIDE 3. SURFACE GRIND TO FINISHED SIZE REFER TO: X-H-1c (TS) NOTE: HOLD 3.000" ± .005" 4. REMOVE V-BLOCKS FROM MAGNETIC CHUCK 5. BURR ALL EDGES WITH HONE 6. WIPE MAGNETIC CHUCK CLEAN
3. GRIND THIRD SIDE (SMALL V-GROOVE)	NOTE: THE FACE AND EACH SIDE OF V-GROOVE WILL BE GROUND BEFORE GRINDING NEXT SIDE

A. SET UP UNIVERSAL VISE	1. WIPE VISE CLEAN 2. POSITION VISE SO JAWS ARE PARALLEL TOGRINDING WHEEL AND TABLE REFER TO: X-H-1c (TS) NOTE: HANDLE OF VISE [illegible] DIRECTED TOWARD OPERATOR 3. TRUE VISE JAWS WITH DIAL INDICATOR NOTE: VISE BASE SHOULD READ 0° 4. SET VISE VERTICAL POSITION AT 0° AS PER IX-M-1 (TS) NOTE: VISE WILL BE ELEVATED TO 45° FOR GRINDING V-GROOVES 5. CUT MAGNETIC CHUCK ON
B. GRIND FACE	1. SET UP AND TRUE WORKPIECE WITH DIAL INDICATOR NOTE: SET UP BOTH V-BLOCKS WITH SMALL V-GROOVE UP CAUTION: DO NOT MOVE VISE OUT OF POSITION WHEN TIGHTENING VISE NOTE: RECHECK WITH DIAL INDICATOR 2. GRIND TO MINIMUM CLEANUP NOTE: ABOUT .005" TO MAINTAIN SPECIFIED TOLERANCE
C. GRIND SMALL GROOVE (FIRST FACE)	1. LOOSEN VISE ANGLE LOCKING BOLT NOTE: PERMITS VERTICAL MOVEMENT OF VISE 2. SET VISE AT 45° ANGLE AS PER IX-M-1 (TS) STEP #3 3. TIGHTEN VISE ANGLE LOCKING BOLTS 4. GRIND GROOVE FACE CAUTION: DO NOT PERMIT SIDE OF GRINDING WHEEL TO TOUCH ADJACENT SIDE OF GROOVE NOTE: ABOUT .005" SHOULD BE REMOVED 5. REMOVE WORKPIECE AND BURR EDGES 6. INSPECT WORKPIECE 7. WIPE VISE CLEAN
D. GRIND SMALL GROOVE (SECOND FACE)	1. TURN WORKPIECES END FOR END NOTE: THE FINISH GROUND FACE OF GROOVE WILL BE NEAR OPERATOR 2. SETUP AND TRUE WORKPIECE AS PER STEP #3-C

	3. GRIND GROOVE FACE AS PER STEP #3-C NOTE: REMOVE .005" 4. REMOVE WORKPIECE AND BURR EDGES 5. INSPECT WORKPIECE 6. WIPE VISE CLEAN
4. GRIND FOURTH SIDE (LARGE V-GROOVE)	NOTE: THE FACE AND EACH SIDE OF V-GROOVE WILL BE GROUND BEFORE GRINDING NEXT SIDE
A. SET UP UNIVERSAL VISE	1. SET UP UNIVERSAL VISE POSITION AS PER STEP #3-A NOTE: VISE BASE SHOULD BE 0° NOTE: VISE VERTICAL POSITION SHOULD BE 0° 2. SET UP AND TRUE WORKPIECE AS PER STEP #3-B
B. GRIND FACE	1. GRIND TO FINISH SIZE NOTE: HOLD 3.000" ± .005 2. WIPE VISE CLEAN
C. GRIND LARGE GROOVE (FIRST FACE)	1. SET VISE AT 45° ANGLE AS PER STEP #3-C 2. GRIND GROOVE FACE NOTE: REMOVE ABOUT .005" CAUTION: DO NOT LET WHEEL TOUCH ADJACENT V SIDE 3. REMOVE WORKPIECE AND BURR EDGES 4. INSPECT WORKPIECE 5. WIPE VISE CLEAN
D. GRIND LARGE GROOVE (SECOND FACE)	1. SET UP WORKPIECE AND FINISH GRIND AS PER STEP #3-D NOTE: REMOVE .005" 2. REMOVE WORKPIECE AND BURR EDGES 3. INSPECT WORKPIECE 4. WIPE VISE CLEAN
5. GRIND FIRST END	1. SET UP VISE AS PER STEP #1 NOTE: VISE VERTICAL POSITION SHOULD BE AT 0° 2. SET UP AND TRUE WORKPIECE AS PER PREVIOUS STEPS 3. FINISH GRIND END NOTE: REMOVE .005" 4. REMOVE WORKPIECE AND BURR EDGES 5. INSPECT WORKPIECE 6. WIPE VISE CLEAN

6. GRIND SECOND END

1. SET UP AND TRUE WORKPIECE
   NOTE: END PREVIOUSLY GROUND IN STEP #5 WILL BE FACE DOWN
2. FINISH GRIND END
   NOTE: HOLD 4" AS PER DRAWING
3. REMOVE WORKPIECE AND BURR
4. INSPECT BOTH V-BLOCKS
5. CLEAN MACHINE

SKETCHES: DRAWING #19: V-BLOCK

REFERENCES: REF. #1, PP. 33-8 TO 33-13
REF. #2, PP. 569-582
REF. #3, PP. 287-310

385

MACHINE SHOP STANDARD RING GAGES

ENGINE LATHE 17

SAW 4

BENCH 12

HEAT TREAT 7

INTERNAL GRINDER 2

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, OPERATE DESIGNATED MACHINES, AND CONSTRUCT TWO RING GAGES (ONE GO AND ONE NO GO) ACCORDING TO SPECIFICATIONS.

CHECKING STANDARDS

1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
2. HOLD ALL SURFACES TO PRECISION FINISH.
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT.
5. MAINTAIN A SAFETY ATTITUDE.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

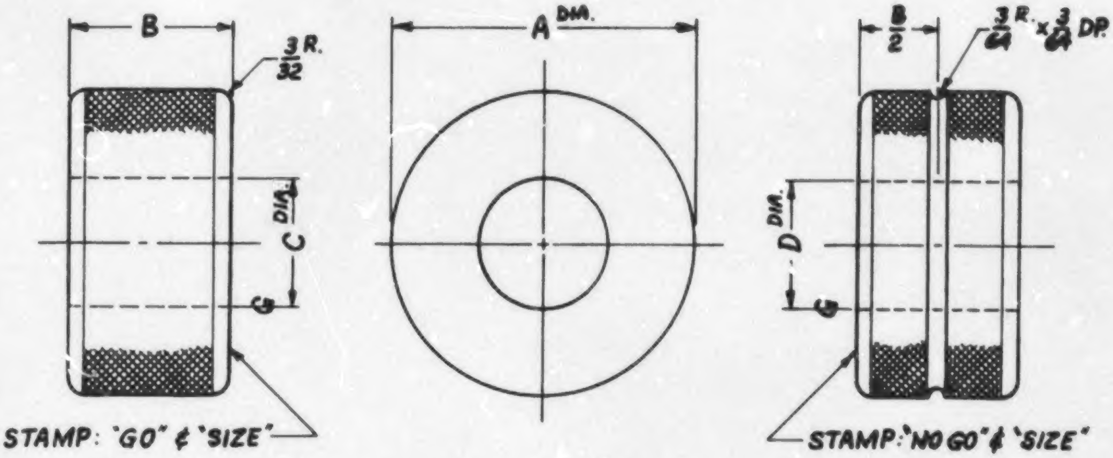
REF. #2, LUDWIG, OSWALD A. AND MCCARTHY, WILLARD J., METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

REF. #4, MCCARTHY, WILLARD J. AND SMITH, ROBERT E., MACHINE TOOL TECHNOLOGY.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED TO CONSTRUCT A STANDARD GO RING GAGE AND A STANDARD NO GO RING GAGE. THIS IS REF. #6 ON DRAWING #20, STANDARD RING GAGES. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.

IN THIS JOB, ALL TASKS THAT HAVE BEEN PREVIOUSLY PERFORMED WILL BE WRITTEN AS STEPS IN CONSTRUCTING THE STANDARD RING GAGE. THOSE TASKS THAT HAVE NOT BEEN PERFORMED PREVIOUSLY WILL BE WRITTEN AS SUCH. REFERENCE WILL BE MADE TO PREVIOUS TASKS SHOULD THE STUDENT REQUIRE SUCH ASSISTANCE.


B
$\frac{3}{32}$ R.
A DIA.
$\frac{B}{2}$
$\frac{3}{64}$ R. x $\frac{3}{64}$ DP.
C DIA.
D DIA.
℄
℄
STAMP: "GO" & "SIZE"
STAMP: "NO GO" & "SIZE"

REF. #	NOMINAL SIZE	A	B	C	D
1	$\frac{3}{8}$	$1\frac{3}{8}$	$\frac{3}{4}$	.3755	.3745
2	$\frac{1}{2}$	$1\frac{3}{4}$	$\frac{15}{16}$	.5005	.4995
3	$\frac{5}{8}$	$1\frac{3}{4}$	$\frac{15}{16}$	.6255	.6245
4	$\frac{3}{4}$	$1\frac{3}{4}$	$\frac{15}{16}$	.7505	.7496
5	$\frac{7}{8}$	$2\frac{1}{8}$	$1\frac{1}{8}$	.8756	.8745
6	1	$2\frac{1}{8}$	$1\frac{1}{8}$	1.0005	.9995

DRAWING NO. 20	STANDARD RING GAGES	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 17 INTERNAL GRINDER JOB NO. 2 HEAT TREAT JOB NO. 7	MATERIAL: 4140 H.R.S. FINISH: HDN. & GRIND SCALE: NONE	FRACTIONS . ± 1/64" DECIMAL . ± .0001" ANGLES . ± 1/4 °

VII-R-1 (J)

JOB SHEET
ON
ENGINE LATHE

JOB: STANDARD RING GAGES

MATERIALS: ONE PIECE 2 1/4" X 4" ROUND 4140 STEEL, ENGINE LATHE, INDEPENDENT CHUCK, FACING TOOL, CENTERDRILL, TAILSTOCK DRILLCHUCK AND KEY, 15/16" DRILL, BORING TOOL, CUT-OFF TOOL, TURNING TOOL, KNURLING TOOL. 3/32" GROOVING TOOL, MILL FILE, DIAL INDICATOR, NUMBER AND LETTER STAMPS, BALL PEEN HAMMER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ, REFERENCE #1, PP. 36-1 TO 36-44, AND REFERENCE #2, PP. 462-294. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES.

PROCEDURES AND/OR TASKS:

VII-B-1 (TS)	CHECK ENGINE LATHE FOR PROPER OPERATING CONDITION
VII-L-1 (TS)	SET UP INDEPENDENT CHUCK AND TRUE WORKPIECE
VII-R-1 (TS)	MACHINE STANDARD "GO" AND "NO GO" GAGE ON LATHE ROUTE TO BENCH
IV-A-1 (TS)	STAMP SIZE ON GO AND NO GO GAGES ROUTE TO HEAT TREAT
XI-A-1 (TS)	CHECK FURNACE FOR PROPER OPERATING CONDITION
XI-A-1a (TS)	LIGHT FURNACE
XI-A-1b (TS)	HEAT TREAT WORKPIECE ROUTE TO INTERNAL GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINES FOR PROPER OPERATING CONDITION.
2. CHECK MACHINES FOR PROPER SETUPS.
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

VII-R-1 (TS)

TASK: MACHINE STANDARD "GO" AND "NO GO" GAGES ON LATHE

JOB: STANDARD RING GAGES

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, INDEPENDENT CHUCK, FACING TOOL, CENTER DRILL, TAILSTOCK DRILL CHUCK AND KEY, 15/16" DRILL, BORING TOOL, CUT-OFF TOOL, TURNING TOOL, KNURLING TOOL, 3/64"^{R} GROOVING TOOL, MILL FILE, DIAL INDICATOR, SHIM STOCK, INSIDE MICROMETER OR TELESCOPING GAGES, 0-1" MICROMETER, 1"-2" MICROMETER, 2"-3" MICROMETER, 3/32"^{R} FORMING TOOL, NUMBER AND LETTER STENCILS, BALL PEEN HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK WORKPIECE	1. SET UP 4 - JAW INDEPENDENT CHUCK 2. SET UP AND TRUE WORKPIECE AS PER VII-L-1 (TS) NOTE: MATERIAL WILL EXTEND OUT, TO SUFFICIENTLY CLEAR FOR MACHINING BOTH GAGES, ABOUT 3"
2. FACE AND CENTERDRILL	1. REFER TO: VII-C-1 (TS) 2. FACE TO CLEAN UP END 3. #5 CENTERDRILL IS RECOMMENDED
3. TURN DIAMETER OF WORKPIECE	1. REFER TO: VII-B-1e (TS) 2. SUPPORT END OF WORKPIECE WITH LIVE CENTER NOTE: LUBRICATE CENTER 3. TURN DIAMETER TO 2.125" NOTE: TURN LENGTH TO 2 3/4", AS THIS WILL MAKE BOTH GAGES
4. KNURL WORKPIECE	1. REFER TO: VII-C-1a (TS) 2. HOLD LENGTH OF KNURL TO MINIMUM 2 1/2" LENGTH CAUTION: DO NOT RUN TOOL INTO CHUCK
5. DRILL 15/16" HOLE	1. REFER TO: VII-D-1 (TS) 2. REPLACE LIVE CENTER WITH 15/16" TAPER SHANK DRILL

		2.	HOLD 3" DEPTH TO CLEAR BORING TOOL AND ALLOW FOR CUTTING WORKPIECE OFF
6.	BORE HOLE TO .990"	1.	REFER TO: VII-G-1b (TS)
		2.	SET UP BORING TOOL
		3.	BORE TO SPECIFIED DIAMETER NOTE: HOLD .990" DIAMETER
		4.	BORE TO 2 3/8" MINIMUM DEPTH NOTE: BORE BOTH GAGES AT ONE TIME UNLESS LIMITED BY TOOL LENGTH
7.	TURN 3/32" RADIUS		REFER TO: VII-B-1f (TS)
8.	TURN 3/64"^{R} GROOVE	1.	REFER TO: VII-F-1b(TS)
		2.	CENTER LINE OF GROOVE HELD TO REFERENCE $\frac{B}{2}$ DIMENSION OR ON THIS JOB, 9/16" FROM END NOTE: HOLD 3/64" DEPTH AS SPECIFIED
9.	CUT-OFF WORKPIECE NOTE: THIS WILL BE THE "NO GO" GAGE	1.	REFER TO: VII-A-1b (TS)
		2.	HOLD 1 3/16" ON LENGTH TO ALLOW FOR FACING
		3.	BURR EDGES
10.	FACE END OF "GO" GAGE	1.	REFER TO: VII-C-1 (TS)
		2.	FACE TO CLEAN UP ONLY NOTE: SHOULD THE GAGES BE BORED SEPARATE, BORE HOLE .990" DIAMETER 1 3/8" DEEP AS PER STEP 6
11.	TURN 3/32" RADIUS		REFER TO: VII-B-1f (TS)
12.	CUT-OFF WORKPIECE ("GO" GAGE)	1.	AS PER STEP 9 NOTE: HOLD 1 3/16" LENGTH FOR FACING
		2.	BURR EDGES
13.	FACE AND TURN RADIUS ON BOTH UNFINISHED ENDS NOTE: FIRST GAGE WILL BE COMPLETED BEFORE REMOVAL AND SETUP ON OTHER GAGE IS MADE	1.	REMOVE UNUSED STOCK
		2.	CHUCK AND TRUE IN INDEPENDENT CHUCK NOTE: PROTECT KNURLS WITH SHIM MATERIAL
		3.	FACE END. HOLD 1 1/8" LENGTH
		4.	SET UP AND TURN 3/32" RADIUS AS PER STEP 7
		5.	BURR EDGES
		6.	REMOVE FROM CHUCK
		7.	INSPECT

8. ROUTE TO BENCH

14. STAMP SIZE ON GAGES

1. STAMP 1.000" ON FACE OF EACH PART AS PER DRAWING
2. STAMP "GO" ON "GO" GAGE AND "NO GO" ON "NO GO" GAGE

NOTE: "NO GO" GAGE HAS 3/64" RADIUS GROOVE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #20: STANDARD RING GAGES

REFERENCES: REF. #1, PP. 36-1 TO 36-44
REF. #2, PP. 462-464

X-K-1 (J)

JOB SHEET
ON
INTERNAL GRINDER

JOB: STANDARD RING GAGES

MATERIALS: 2 - STANDARD RING GAGES AS MACHINED ON THE LATHE, SIZE STAMPED ON THE BENCH, AND HEAT TREATED TO SPECIFICATIONS

TOOLS AND EQUIPMENT: INTERNAL GRINDER, 3/4" GRINDING WHEEL, DIAMOND DRESSING TOOL, DIAL INDICATOR, INDEPENDENT CHUCK, HONE, INSIDE MICROMETER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 33-1 TO 33-15; REF. #3, PP. 297-310; REF. #4, PP. 446-470. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

NOTE: JOB AND TASK SHEET FOR THIS OPERATION ARE REFERRED TO THE INTERNAL GRINDER. SHOULD EITHER THE TOOL AND CUTTER GRINDER OR TOOL POST GRINDER ON THE LATHE BE USED, REFERENCE WILL BE MADE FOR THE STUDENT'S BENEFIT.

PROCEDURES AND/OR TASKS:	X-A-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	VII-L-1 (TS)	TRUE WORKPIECE IN INDEPENDENT CHUCK
	X-H-2 (TS)	SET UP TOOLING FOR INTERNAL GRINDING
	X-H-2a (TS)	GRIND INTERNAL TAPER
ALTERNATE TASKS:	X-H-3 (TS)	SET UP TOOLING FOR INTERNAL GRINDING ON LATHE WITH TOOL POST GRINDER
	X-H-3a (TS)	GRIND INTERNAL TAPER WITH TOOL POST GRINDER
	X-H-4 (TS)	SET UP TOOL AND CUTTER GRINDER FOR INTERNAL GRINDING
	X-H-4a (TS)	GRIND INTERNAL TAPER WITH TOOL AND CUTTER GRINDER

NOTE: HOLD 1.0005" ± .0001 ON "GO" GAGE I.D. HOLD .9995 ± .0001 ON "NO GO" GAGE I.D.

NOTE: ALTHOUGH REFERENCE TASKS CALLS FOR A TAPER, DO NOT TAPER HOLE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINES FOR PROPER OPERATING CONDITION.
2. CHECK MACHINES FOR PROPER SETUP.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

MACHINE SHOP TAP WRENCH

ENGINE LATHE 18

DRILL PRESS 6

BENCH 13

HORIZONTAL MILLING MACHINE 15

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A TAP WRENCH ACCORDING TO SPECIFICATIONS.

CHECKING STANDARDS

1. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
2. HOLD ALL SURFACES TO PRECISION FINISH.
3. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
4. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK PERFORMED, MATERIALS, TOOLS, AND EQUIPMENT.
5. MAINTAIN A SAFETY ATTITUDE.

REFERENCES

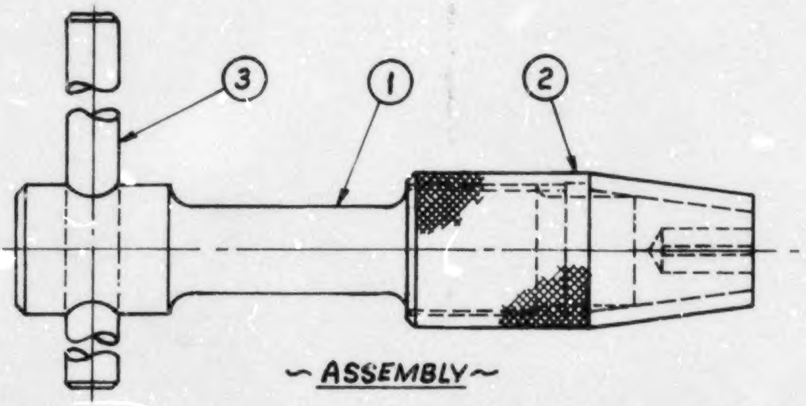
REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A., AND MCCARTHY, WILLARD, METALWORK TECHNOLOGY AND PRACTICE.

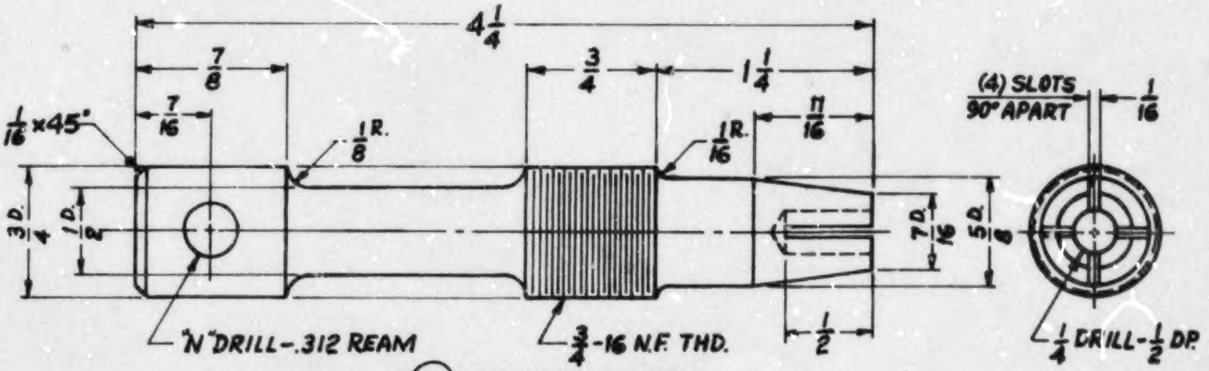
REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

REF. #4, MCCARTHY, WILLARD J., AND SMITH, ROBERT E., MACHINE TOOL TECHNOLOGY.

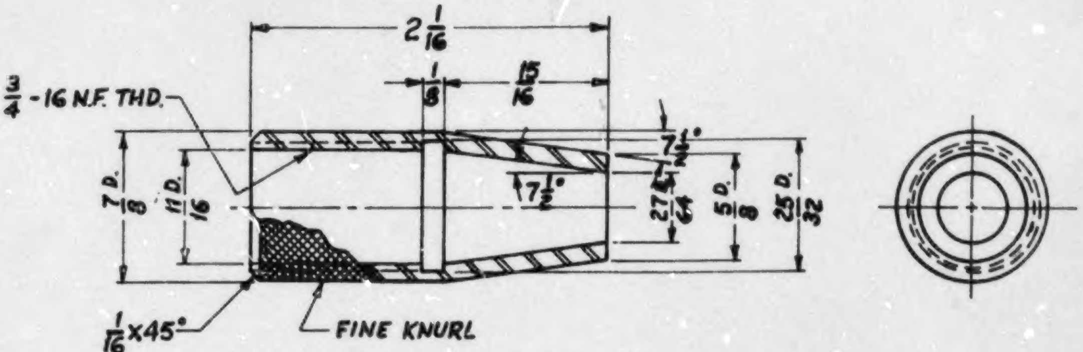
NOTE: IN THIS JOB, THE STUDENT WILL GET ALL NECESSARY MATERIALS FROM SUPPLY PRIOR TO STARTING TASKS FOR CONSTRUCTION OF THIS MULTI-PART JOB. THE STUDENT IS CHARGED WITH KEEPING TRACK OF EACH AND ALL PARTS. THE JOB AND TASK SHEETS ARE WRITTEN FOR COMPLETION OF EACH PART BEFORE PROCEEDING TO THE NEXT PART. IN THIS JOB, TASKS THAT HAVE BEEN REPEATED PREVIOUSLY WILL BE CONSIDERED AS STEPS WITHIN THE TASK OF CONSTRUCTING EACH PART. REFERENCE WILL BE GIVEN TO THOSE PREVIOUS TASKS THAT ARE USED IN THE KEY POINTS. SPECIAL KEY POINTS WILL BE NOTED PERTAINING TO SET UP AND SPECIFICATIONS, WITH TASK SHEETS WRITTEN FOR THOSE TASKS OR SPECIAL TASKS NOT PREVIOUSLY PERFORMED.



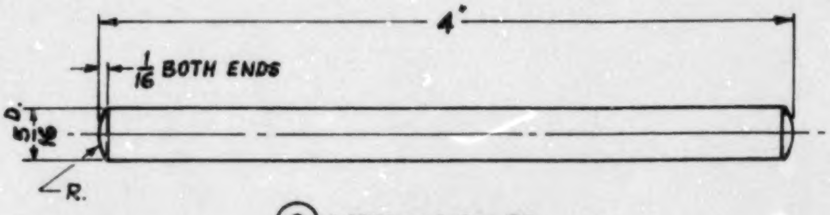
~ ASSEMBLY ~


4 1/4
7/8
7/16
3/4
1 1/4
11/16
1/16 × 45°
1/8 R.
1/16 R.
(4) SLOTS 90° APART
1/16
3/4 D.
1/2 D.
7/16 D.
5/8 D.
"N" DRILL - .312 REAM
3/4 - 16 N.F. THD.
1/2
1/4 DRILL - 1/2 DP.

① MAT'L: TOOL STEEL


2 1/16
1/8
15/16
3/4 - 16 N.F. THD.
7 1/2°
7 1/2°
7/8 D.
11/16 D.
27/64 D.
5/8 D.
25/32 D.
1/16 × 45°
FINE KNURL

② MAT'L: TOOL STEEL


4"
1/16 BOTH ENDS
5/16 D.
R.

③ MAT'L: 1018 C.R.S.

DRAWING NO. 21	TAP WRENCH	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 18 MILLING JOB NO. 15 DRILL PRESS JOB 6	MATERIAL: AS NOTED FINISH: POLISH SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

VII-S-1(J)

JOB SHEET
ON
ENGINE LATHE

JOB: TAP WRENCH

MATERIAL: PART #1, TAP WRENCH BODY, 1018 COLD ROLL 3/4" DIAMETER X 4 3/8" LONG

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 3/4" COLLET, FACING TOOL, #2 CENTER DRILL, RIGHT HAND TURNING TOOL, TAILSTOCK DRILL CHUCK AND KEY, LIVE CENTER, 1/8" RADIUS ROUNDNOSE TURNING TOOL, 60° THREADING TOOL, CENTER GAGE, SCREW PITCH GAGE, 0-1" MICROMETER, 6" RULE, 1/4" DRILL, 1/8" RADIUS L.H. TURNING TOOL, 1/8" R.H. TURNING TOOL

NOTE: R.H. AND L.H. RADIUS TOOL NOT REQUIRED SHOULD 1/8" RADIUS ROUNDNOSE TURNING TOOL BE USED

240 GRIT ALUMINUM OXIDE, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #3, PP. 135-208; AND REF. #4, PP. 217-219. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

VII-B-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-S-1 (TS)	MACHINE TAP WRENCH BODY ON LATHE ROUTE TO BENCH
IV-B-1 (TS)	LAY OUT AND LOCATE CENTER FOR HOLE ROUTE TO DRILL PRESS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

TASK: MACHINE TAP WRENCH BODY ON LATHE

JOB: TAP WRENCH

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, COLLET ATTACHMENT, 3/4" COLLET, FACING TOOL, #2 CENTER DRILL, RIGHT HAND TURNING TOOL, TAILSTOCK DRILL CHUCK AND KEY, LIVE CENTER, 1/8" RADIUS ROUNDNOSE TURNING TOOL, 60° THREADING TOOL, CENTER GAGE, SCREW PITCH GAGE, 0-1" MICROMETER, 6" RULE, 1/4" DRILL, 1/8" RADIUS L.H. TURNING TOOL, 1/8" R.H. TURNING TOOL
NOTE: R.H. AND L.H. RADIUS TOOL NOT REQUIRED SHOULD 1/8" RADIUS ROUNDNOSE TURNING TOOL BE USED
240 GRIT ALUMINUM OXIDE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK WORKPIECE	1. SET UP COLLET ATTACHMENT WITH 3/4" COLLET. REFER TO: VII-A-1a (TS) 2. CHUCK WORKPIECE IN COLLET NOTE: WORKPIECE EXTENDED OUT 1" TO CLEAR FACING, TURNING 1/16" X 45° BEVEL, AND POLISHING END
2. FACE WORKPIECE	REFER TO: VII-B-1b (TS) NOTE: FACE ONLY TO CLEAN UP
3. TURN 1/16" X 45° BEVEL	REFER TO: VII-B-1b (TS) NOTE: POLISH PART EXTENDED OUT WITH 240 GRIT ABRASIVE
4. RECHUCK WORKPIECE	1. CHUCK FACED AND BEVELED END INTO COLLET 2. CHUCK WITH WORKPIECE EXTENDED OUT FROM CHUCK 3 5/8" NOTE: THIS WILL CLEAR FOR ALL OTHER TASKS
5. FACE AND CENTERDRILL END	1. REFER TO: VII-C-1 (TS) 2. HOLD 4 1/4" ON LENGTH OF WORKPIECE 3. CENTERDRILL WITH #2 CENTERDRILL 4. REMOVE DRILL CHUCK 5. INSERT LIVE CENTER

6. TURN END TO 5/8" DIAMETER	1. MOVE LIVE CENTER AGAINST WORKPIECE 2. SET UP TURNING TOOL 3. TURN DIAMETER. HOLD 5/8" DIAMETER 1 1/4" FROM END. REFER TO: VII-B-1e (TS)
7. TURN WORKPIECE TO 1/2" DIAMETER	1. SCRIBE LINE 3 3/8" FROM END NOTE: THIS IS THE LEFT EDGE OF 1/2" DIAMETER 2. SCRIBE LINE 2" FROM END NOTE: THIS REPRESENTS THE RIGHT EDGE OF 1/2" DIAMETER 3. ROUGH TURN DIAMETER TO 31/64" NOTE: HOLD 1/8" FROM EACH LAYOUT LINE FOR 1/8" RADIUS NOTE: USE ROUNDNOSE TURNING TOOL IF AVAILABLE 4. FINISH TURN DIAMETER TO 1/2" NOTE: A 1/8" RADIUS ROUNDNOSE TURNING TOOL SHOULD BE USED OR A LEFT HAND AND RIGHT HAND TURNING TOOL WITH A 1/8" RADIUS NOTE: HOLD 1/2" DIAMETER 1 3/8" LONG NOTE: BLEND RADIUS IN TO TURNED DIAMETER AVOIDING CHATTER MARKS OR UNDERCUT
8. TURN 7 1/2° TAPER	1. SET UP TAPER ATTACHMENT. REFER TO VII-B-1h (TS) 2. TURN TO SPECIFIED DIAMETER NOTE: HOLD 7/16" DIAMETER ON END, 11/16" LONG 3. REMOVE TURNING TOOL
9. TURN 3/4"-16 NF THREAD	1. SET UP 60° THREADING TOOL 2. SET GEAR BOX FOR 16 PITCH THREAD 3. SET SPINDLE SPEED TO ABOUT 1/4 TURNING SPEED 4. TURN 16 THREADS PER INCH. REFER TO VII-I-1 (TS) NOTE: 3/4" LENGTH AS PER DRAWING 5. CLEAN AND CHECK THREADS 6. REMOVE THREADING TOOL
10. SET UP AND DRILL 1/4 " HOLE	1. REMOVE LIVE CENTER 2. PLACE DRILL CHUCK IN TAILSTOCK

	SPINDLE 3. CHUCK 1/4" DRILL 4. DRILL 1/4" HOLE. REFER TO: VII-D-1 (TS) NOTE: HOLD 1/2" DEPTH 5. BURR EDGES 6. REMOVE DRILL AND DRILL CHUCK
11. POLISH WORKPIECE	1. SET SPINDLE SPEED. ABOUT 4 TIMES TURNING SPEED 2. DISENGAGE LEAD SCREW AND FEED ROD 3. CHECK FOR ANY LOOSE CLOTHING 4. SELECT A PIECE OF ABRASIVE ABOUT 6" LONG NOTE: EITHER 1" OR 1 1/2" WIDE ALUMINUM OXIDE 5. POLISH BY MOVING ABRASIVE SLOWLY BACK AND FORTH ALONG WORKPIECE NOTE: DO NOT OVER POLISH. HOLD ALL DIMENSIONS AS SPECIFIED 6. ROUTE TO BENCH TO LAY OUT HOLE TO BE DRILLED ON TAP WRENCH BODY

SKETCHES: DRAWING #21: TAP WRENCH

REFERENCES: REF: #3, PP. 135-208
REF: #4, PP. 217-291

VI-E-1 (J)

JOB SHEET
ON
DRILL PRESS

JOB:	TAP WRENCH
MATERIAL:	TAP WRENCH BODY AS MACHINED ON LATHE
TOOLS AND EQUIPMENT:	DRILL PRESS, V-BLOCKS AND CLAMP, CENTER DRILL, "N" DRILL, .312" REAMER, THREAD CUTTING OIL, SMALL ROUND FILE, DRILL PRESS VISE
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #3, PP. 95-120 AND REF. #4, PP. 143-210. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE
PROCEDURES AND/OR TASKS:	VI-A-1 (TS) CHECK DRILL PRESS FOR PROPER OPERATING CONDITION VI-B-1 (TS) SET UP IN V-BLOCKS AND DRILL SIZE "N" HOLE VI-E-1 (TS) SET UP AND REAM HOLE TO .312" DIAMETER ROUTE TO HORIZONTAL MILLING MACHINE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. CHECK MACHINE FOR PROPER OPERATING CONDITION 2. CHECK MACHINE FOR PROPER SETUP 3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS 4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

VI-E-1 (TS)

TASK: DRILL AND REAM .312" DIAMETER HOLE

JOB: TAP WRENCH

TRADE: MACHINIST

TOOLS AND MATERIALS: DRILL PRESS, DRILL PRESS VISE, V-BLOCKS AND CLAMP, SIZE "N" DRILL, .312" REAMER (5/16"), SMALL ROUND FILE, THREAD CUTTING OIL, CENTER DRILL, DRILL CHUCK, WIGGLER OR DIAL INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK WORKPIECE	NOTE: WHERE AT ALL POSSIBLE, THE SETUP FOR DRILLING AND REAMING A HOLE SHOULD NOT BE CHANGED. SHOULD CHANGING BE NECESSARY PRIOR TO REAMING HOLE, INDICATE WORKPIECE TO INSURE ACCURACY OF REAMED HOLE
	1. CLAMP WORKPIECE IN V-BLOCKS AS PER VI-B-1 (TS)
	2. CLAMP V-BLOCK IN DRILL PRESS VISE NOTE: PARALLEL BARS MAY BE NEEDED TO CLEAR V-BLOCK CLAMPS
	3. FASTEN DRILL PRESS VISE TO TABLE NOTE: RIGIDITY IS GIVEN TO WORKPIECE ASSURING BETTER ACCURACY
2. POSITION DRILL TABLE	1. HEIGHT OF TABLE MUST BE SUCH THAT TRAVEL OF QUILL WILL PERMIT DRILL AND REAMER TO GO COMPLETELY THROUGH WORKPIECE AS SPECIFIED
	2. SUFFICIENT CLEARANCE SHOULD BE MADE IF POSSIBLE FOR INTERCHANGING DRILL AND REAMER WITHOUT CHANGING SET UP OR TABLE POSITION
3. SET UP FOR DRILLING	REFER TO VI-A-1a (TS)
A. CENTER DRILL	1. CHUCK CENTER DRILL NOTE: THIS SERVES AS A PILOT FOR THE DRILL
	2. CENTER DRILL HOLE NOTE: SIZE OF CENTER DRILLED HOLE

	SHOULD BE AS LARGE AS DRILL POINT 3. REMOVE CENTER DRILL
B. DRILL HOLE	1. REPLACE CENTER DRILL WITH SIZE "N" DRILL NOTE: DO NOT CHANGE POSITION OF TABLE OR WORKPIECE 2. SET SPINDLE SPEED AND FEED. SEE REF. #3, P. 105 AND REF. #4, PP. 198-201 3. DRILL HOLE TO SPECIFIED SIZE THROUGH NOTE: CHECK ALIGNMENT AND POSITION BEFORE DRILLING 4. DRILL HOLE CAUTION: AVOID HEAVY FEED TO PREVENT DRILL BREAKAGE OR INACCURATELY DRILLED HOLE 5. REMOVE DRILL BIT CAUTION: DO NOT CHANGE SETUP
4. REAM HOLE	
A. SET UP WORKPIECE	1. SETUP WILL REMAIN THE SAME AS FOR DRILLING NOTE: SHOULD IT BE NECESSARY TO MOVE SETUP, CHECK HOLE ALIGNMENT WITH A DIAL INDICATOR OR WIGGLER (CENTER FINDER)
B. SELECT REAMER	1. SELECT TYPE SHANK FOR DRILL PRESS NOTE: EITHER STRAIGHT SHANK CHUCKING REAMER OR TAPER SHANK CHUCKING REAMER 2. FIT REAMER SHANK WITH A SLEEVE, SHOULD A TAPERED SHANK REAMER BE USED
C. INSPECT CONDITION OF REAMER	1. INSPECT CUTTING BLADES FOR SHARPNESS 2. CHECK SIZE WITH MICROMETER 3. INSPECT REAMER FOR BURRS NOTE: HONE CUTTER LIGHTLY TO SHARPEN CUTTERS AND TO REMOVE BURRS 4. CHECK SHANK FOR BURRS NOTE: REMOVE WITH HONE

D.	SET SPEED AND FEED	1. SET SPINDLE SPEED NOTE: REAMING SPEED SHOULD BE 1/2 TO 2/3 DRILLING SPEED 2. SET AUTOMATIC FEED FOR .001" TO .004" FEED PER FLUTE PER REVOLUTION NOTE: FEED SHOULD BE 2 TO 3 TIMES DRILLING FEED WHEN FED BY HAND CAUTION: SHOULD FEED BE TOO SLOW, WORKPIECE WILL GLAZE CAUSING EXCESS REAMER WEAR; SHOULD FEED BE TOO FAST, HOLE ACCURACY IS REDUCED AND POOR SURFACE FINISH IS THE RESULT
E.	REAM TO SIZE	1. INSPECT TO INSURE RIGIDITY AND ACCURACY IN SETUP 2. CUT DRILL PRESS ON 3. HAND FEED REAMER UNTIL FULL DIAMETER OF REAMER IS REACHED 4. RAISE REAMER AND CUT OFF MACHINE 5. INSPECT FOR CONCENTRICITY OF DRILLED AND REAMED HOLE NOTE: SHOULD ALIGNMENT BE OFF MAKE NECESSARY ADJUSTMENTS CAUTION: DO NOT TRY TO MAKE ADJUSTMENT AFTER REAMING HOLE DEEP. THIS WILL CAUSE BREAKAGE OR AN OVERSIZED HOLE 6. FINISH REAM HOLE NOTE: USE AMPLE COOLANT NOTE: SHOULD REAMER CHATTER, RAISE REAMER, STOP MACHINE, AND REDUCE SPEED 7. REMOVE REAMER NOTE: WIPE REAMER AND STORE 8. REMOVE WORKPIECE FROM VISE 9. BURR EDGES 10. ROUTE TO MILLING MACHINE
5.	SECURE DRILL PRESS	REFER TO VI-A-1a

SKETCHES: DRAWING #21: TAP WRENCH

REFERENCES:
REF. #3, PP. 95-120
REF. #4, PP. 193-210

VII-S-2 (J)

JOB SHEET
ON
ENGINE LATHE

JOB: TAP WRENCH

MATERIAL: 1 PIECE - 7/8" X 3 3/16" LONG, 1018 C.R.S. - SLEEVE, 1 PIECE - 5/16" X 4" LONG, 1018 C.R.S. - HANDLE

TOOLS AND EQUIPMENT: ENGINE LATHE, COLLET ATTACHMENT, 7/8" COLLET, 5/8" COLLET, DRILL CHUCK AND KEY, #2 CENTER DRILL, RIGHT HAND TURNING TOOL, KNURLING TOOL, FACING TOOL, 1/8" CUT-OFF TOOL, 27/64" DRILL, 11/16" DRILL, 1/8" SPECIAL INTERNAL GROOVING TOOL, TAP WRENCH, 3/4"-16 NF TAPER TAP, 3/4"-16 NF BOTTOM TAP, 0-1" MICROMETER, INSIDE CALIPERS, 6" RULE, BORING BAR, MILL FILE, 240 GRIT ALUMINUM OXIDE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #3, PP. 135-208, AND REF. #4, PP. 217-291. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE AND FOR OBTAINING SPECIAL INTERNAL GROOVING TOOL

PROCEDURES AND/OR TASKS:

VII-B-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
VII-S-2 (TS)	MACHINE TAP WRENCH SLEEVE ON LATHE
VII-E-1 (TS)	FILE 1/16" RADIUS ON HANDLE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUPS
3. ALL DIMENSIONS HELD TO DRAWING SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

TASK: MACHINE TAP WRENCH SLEEVE ON LATHE

JOB: TAP WRENCH

TRADE: MACHINIST

TOOLS AND MATERIAL: ENGINE LATHE, COLLET ATTACHMENT, 7/8" COLLET, 5/8" COLLET, DRILL CHUCK AND KEY, #2 CENTER DRILL, RIGHT HAND TURNING TOOL, KNURLING TOOL, FACING TOOL, 1/8" CUT-OFF TOOL, 27/64" DRILL, 11/16" DRILL, 1/8" SPECIAL INTERNAL GROOVING TOOL, TAP WRENCH, 3/4"-16 NF TAPER TAP, 3/4"-16 NF BOTTOM TAP, 0-1" MICROMETER, INSIDE CALIPERS, 6" RULE, BORING BAR, MILL FILE, 240 GRIT ALUMINUM OXIDE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK WORKPIECE	1. SET UP COLLET ATTACHMENT WITH 7/8" COLLET. REFER TO: VII-A-1a (TS) 2. CHUCK WORKPIECE IN COLLET NOTE: EXTEND OUT 2 1/4" FROM COLLET
2. FACE END	REFER TO: VII-B-1b (TS). FOR CLEAN UP ONLY
3. TURN 5/8" DIAMETER NOTE: THIS DIAMETER WILL BE FOR HOLDING PURPOSE ONLY	1. SET UP TURNING TOOL 2. TURN DIAMETER. HOLD 5/8" DIAMETER 1" FROM END. REFER TO: VII-B-1e (TS) SEE FIGURE 1 3. REMOVE WORKPIECE FROM COLLET

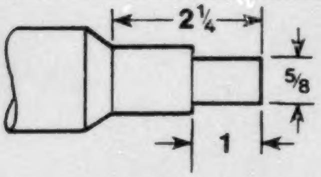
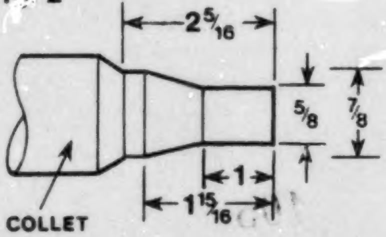
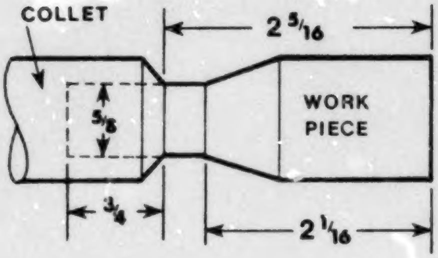


fig. 1

STEPS	KEY POINTS
4. TURN 7 1/2° TAPER	1. SET UP TURNING TOOL 2. SET TAPER ATTACHMENT FOR TURNING 7 1/2° SPECIFIED TAPER 3. TURN TAPER AS PER VII-B-1h (TS) HOLD 5/8" DIAMETER ON SMALL END OF TAPER. SEE FIGURE 2 NOTE: LENGTH OF TAPER WOULD BE

fig. 2

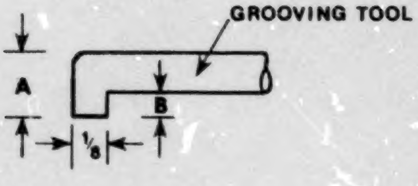


	CONTROLLED BY TAPER. SHOULD BE 15/16" AS SPECIFIED NOTE: THIS END OF SLEEVE WILL BE CUT OFF AND FACED LATER
5. RECHUCK WORKPIECE fig. 1  	1. PLACE 5/8" COLLET IN COLLET ATTACHMENT 2. CHUCK WORKPIECE NOTE: 5/8" DIAMETER WILL BE CHUCKED WITH 3/4" OF WORKPIECE IN COLLET SEE FIGURE 3
6. FACE AND CENTER DRILL END	1. REFER TO VII-C-1 (TS) 2. FACE END AND HOLD 2 1/16" FROM 5/8" DIAMETER END OF TAPER. SEE FIGURE 3 3. CENTER DRILL 4. REMOVE DRILL CHUCK 5. INSERT LIVE CENTER 6. MOVE LIVE CENTER INTO CENTER HOLE NOTE: LUBRICATE CENTER
7. KNURL SLEEVE	1. SET UP KNURLING TOOL NOTE: USE FINE PITCH KNURL AS SPECIFIED 2. KNURL WORKPIECE. REFER TO: VII-C-1b (TS) NOTE: KNURL LENGTH WILL BE CONTROLLED BY THE 7 1/2° TURNED TAPER 3. REMOVE KNURLING TOOL
8. TURN 1/16" X 45° BEVEL	REFER TO VII-F-1a (TS)
9. DRILL 27/64" HOLE	1. REMOVE LIVE CENTER 2. INSERT TAILSTOCK DRILL CHUCK WITH 27/64" DRILL 3. DRILL HOLE. REFER TO: VII-S-1 (TS) HOLD 2 1/4" DEPTH NOTE: THIS WILL CLEAR COMPLETE LENGTH OF TAP WRENCH SLEEVE 4. REMOVE TAILSTOCK DRILL CHUCK AND DRILL

10. DRILL TAP HOLE

1. PLACE 11/16" TAPER SHANK DRILL IN TAILSTOCK SPINDLE
2. DRILL HOLE. REFER TO: VII-D-1 (TS) NOTE: HOLD FULL 11/16" DIAMETER 1" DEEP

11. TURN 1/8" INTERNAL THREAD RELIEF



A NOT TO EXCEED 13/32
B NOT LESS THAN .046

fig. 4

1. SET UP 1/8" SPECIAL GROOVING TOOL REFER TO: VII-O-2 (TS), STEP 9 NOTE: GROOVING TOOL CAN BE MADE AS USED IN THIS TASK. SEE FIGURE 4
2. POSITION TOOL ON CENTER INTO HOLE NOTE: CENTER AXIS OF TOOL MUST BE PARALLEL TO CENTER AXIS OF WORKPIECE
3. TURN GROOVE AS PER VII-O-2 (TS) STEP 9 NOTE: HOLD 49/64" DIAMETER 1" FROM END. SEE FIGURE 5
4. INSPECT GROOVE DIAMETER. SEE FIGURE 5 FOR SPECIFICATIONS
5. REMOVE GROOVING TOOL

12. BORE 7 1/2° TAPER

fig. 5

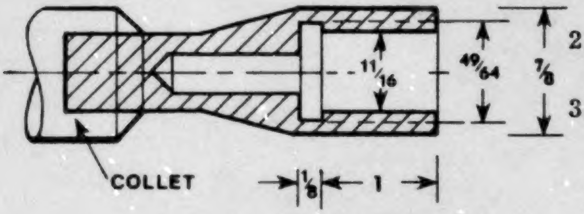
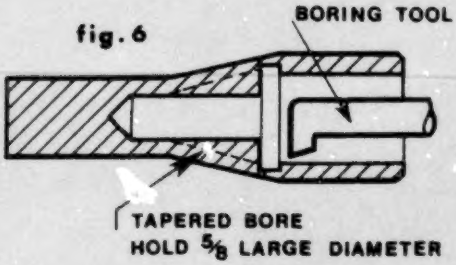


fig. 6



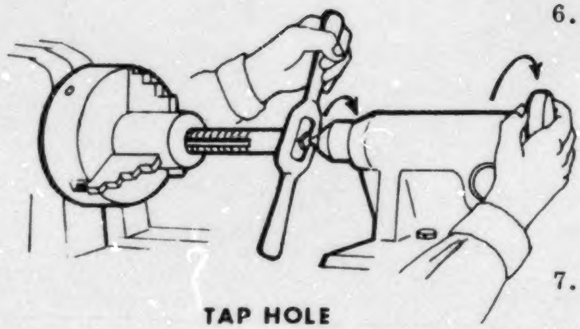
1. SET UP BORING TOOL NOTE: BORING TOOL IS PLACED ON CENTER OF HOLE
2. SET TAPER ATTACHMENT FOR TURNING 7 1/2° SPECIFIED TAPER
3. BORE TAPERED HOLE. REFER TO: VII-M-1 (TS) NOTE: HOLD 5/8" DIAMETER ON THE LARGE DIAMETER NOTE: LENGTH OF TAPER WILL BE CONTROLLED BY 5/8" DIAMETER AND ANGLE OF TAPER. SEE FIGURE 6
4. INSPECT TAPER BORE
5. POLISH TAPER BORE WITH 240 GRIT CAUTION: DO NOT USE FINGER TO HOLD ABRASIVE. USE A PIECE OF WOOD TO HOLD ABRASIVE

13. TAP SLEEVE WITH 3/4"-16 NF TAPER TAP

1. PLACE LIVE CENTER IN TAILSTOCK SPINDLE
2. PLACE 3/4"-16 NF TAPER TAP INTO SLEEVE HOLE
3. SLIDE TAILSTOCK FORWARD UNTIL ABOUT 1" FROM END OF TAP. LOCK SPINDLE

4. PLACE TAP WRENCH ONTO TAP AND TIGHTEN
5. TURN TAILSTOCK HAND WHEEL UNTIL LIVE CENTER POINT IS LOCATED IN CENTER DRILLED HOLE ON TAP SHANK SEE FIGURE 7
6. TAP HOLE AS PER VII-O-2 (TS) STEP 11
   NOTE: USE THREAD CUTTING OIL OR COOLANT FREELY TO AID IN THREAD CUTTING AND CHIP REMOVAL
   NOTE: HOLD 1" THREAD DEPTH
   CAUTION: DO NOT CUT THREADS PAST THREAD RELIEF AS THIS WILL SCAR TAPER
7. REPLACE TAPER TAP WITH BOTTOM TAP
8. TAP HOLE TO FULL THREAD DEPTH
9. REMOVE TAP AND TAP WRENCH
10. SLIDE TAILSTOCK TO THE RIGHT
11. CLEAN AND INSPECT THREADS

fig. 7



TAP HOLE

14. CUT OFF SLEEVE

1. SET UP CUT-OFF TOOL
2. SET SPINDLE AND FEED
   NOTE: FEED MAY BE HAND FED
3. CUT OFF SLEEVE
   NOTE: HOLD 2 1/8" LENGTH TO ALLOW 1/16" FOR FACING
   CAUTION: DO NOT CATCH TAP SLEEVE WITH HANDS, PLACE A WOODEN ROD INTO SLEEVE TO CATCH AS IT CUTS OFF

15. FACE TAPERED END

1. REMOVE 5/8" COLLET
2. INSERT 7/8" COLLET AND SET UP WORKPIECE
   NOTE: CLAMP SLEEVE CLOSE TO START OF TAPER
3. FACE END. HOLD 2 1/16" LENGTH
4. BURR ALL EDGES
5. INSPECT SMALL DIAMETER OF BORED HOLE
6. REMOVE FROM COLLET
7. ROUTE TO HEAT TREAT

SKETCHES: DRAWING #21: TAP WRENCH

REFERENCES: REF. #3, PP. 135-208
REF. #4, PP. 217-291

IX-N-1 (J)

JOB SHEET
ON
MILLING MACHINE

JOB:	TAP WRENCH
MATERIAL:	TAP WRENCH BODY AS MACHINED ON LATHE
TOOLS AND EQUIPMENT:	HORIZONTAL MILLING MACHINE, DIVIDING HEAD, ARBOR, SPACING COLLARS, 6" RULE, 1/16" SLITTING SAW
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #3, PP. 229-286 AND REF. #4, PP. 317-372. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE

PROCEDURES AND/OR TASKS:	IX-A-1 (TS)	CHECK MACHINE FOR PROPER OPERATING CONDITION
	IX-B-1 (TS)	SET UP DIVIDING HEAD
	IX-L-1 (TS)	MILL 1/16" SLOTS IN TAP WRENCH BODY HOLD FOR ASSEMBLY

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MACHINE FOR PROPER OPERATING CONDITION
2. CHECK MACHINE FOR PROPER SETUP
3. ALL DIMENSIONS HELD TO SPECIFICATIONS
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS
5. SAFE WORKING HABITS